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THE VALUES OF γ AND J.

MR. DONALDSON, in his letter on page 152 of our last issue, says we ought to "have carefully eschewed personalities and stuck to facts, reasons and arguments." The personalities introduced by us were that Mr. Donaldson is, we are told, a Cambridge Wrangler and well-known engineer. Perhaps we are in error about the Wrangler with the big W which we intended, and surely no one needed to be told that he is a wrangler with a little *w*, so on this point we would have done well to have followed Mr. Donaldson's modest advice. Having thus disposed of the personalities we come now to the "facts, reasons and arguments."

Fact 1.—We have shown that equation (32) in Sir W. Thomson's article, "Encyclopædia Britannica," is not one having reference to the value of J, in the sense of determining that value.

Reason 1.—Because, if J were made = 0 instead of = 772 the difference in the temperature of melting ice would be only ·13°.

Argument 1.—Therefore no one, except Mr. Donaldson, would ever require to be informed that that equation was never intended for this use.

To these Mr. Donaldson replies, "If your reviewer had been more in touch with the engineering professional world he would have known that the result of equation (32) has been regarded as a strong corroboration of the correctness of Joule's value of J."

We challenge him to produce even a single quotation from the writings of anyone in "the engineering professional world," other than Mr. Donaldson himself, to the effect that the correctness of Joule's value of J is confirmed by the result of that equation.

Fact 2.—In quoting Maxwell against Thomson, Mr. Donaldson suppresses the statements made by Maxwell that the absolute temperature is higher than that indicated by the air thermometer.

Reason 2.—He gives Maxwell's formula for t_o, neglecting this correction, and says, "this method of calculation applies to all gases." But Maxwell at the very outset states that the "Gaseous Laws" are not to be regarded as strictly accurate; his words are, "it is found that actual gases fulfil with greater or less degrees of accuracy certain numerical laws, which are commonly referred to as the "Gaseous Laws."

Argument 2.—Whereas Mr. Donaldson says that Maxwell and Thomson cannot both be right; attention to Maxwell's remarks about the error of the gaseous thermometer shows that both are right and only Mr. Donaldson in error.

Mr. Donaldson's reply to our No. 2 fact, reason and argument, is: "I have not given Maxwell's formula for calculating t_o. The formula quoted is the formula of Boyle and Marriotte, which Maxwell used." Will Mr. Donaldson deny that the words used by him are, "Maxwell's method of computing the temperature of melting ice?" And if so, is it not a contemptible quibble to object to the statement that he gave "Maxwell's formula for calculating t_o?" Is "Maxwell's formula for calculating" not equivalent to "Maxwell's method of computing," and is not t_o the symbol for "the temperature of melting ice?"

He wrangles with a very small *w* who shelters under such a quibble, pretending to ignore our fact No. 2 that he has concealed, as he still tries to conceal, that Maxwell gave the law of Boyle and Marriotte as approximate only, and requiring a correction when applied to actual gases, such as air and hydrogen. These corrections were then based principally on the porous plug experiments, but since these were made other experiments on a far larger scale, eclipsing even Regnault's, have been carried out by M. Amagat to ascertain by the direct method how the product, $p\,v$, varies with pressure at constant temperature. These are fully described and the results plotted in *Ann. de Chimie*, 1880, and *Comptes Rendus*, 1884. They corroborate the results of the porous plug experiments; but any one may exclaim, "They are unreliable."

Mr. Donaldson points out "another error committed by Sir William Thomson. Why should the correction . . . . be a deduction in the case of hydrogen and an addition in the case of air?" If he will examine the plate given by M. Amagat, he will see that after a certain pressure for each the correction for all gases is of the same sign as that for

hydrogen, as demonstrated by the porous plug experiments. We could tell him why, but pearls are precious, and we not over tough.

Fact 3.—Mr. Wm. Donaldson, in his last week's letter, says :—"Since Regnault's value of the factor $\frac{k}{\pi v_o}$ for air—which differs from his value for hydrogen by about one-half per cent.—has been used, his value for the factor $\frac{100}{E}$ for air, not for hydrogen, should have been used also; but then the resulting value of t_o would have been 272·73°." Mr. Donaldson's error here is one any careless reader may very readily fall into; we will therefore demonstrate that his statement is quite erroneous.

Reason 3.—Because the slight deviation from the perfect gas criterion observable with hydrogen shows that hydrogen, as available for experiment, is more nearly in the state of "perfect" gas than air is, therefore hydrogen is more suitable for accurate experiment on the temperature of melting ice.

Reason 3A.—The objection starts upon using the air value, ·0126, in the second term of the value of t_o in (32), instead of the hydrogen value, which Mr. Donaldson says differs from that by about one-half per cent. Now, as the whole value of the second term amounts to only ·13° in the value of t_o, it is obvious that a difference of one-half per cent. in that value will make a difference of only the 200th part of ·13° upon t_o, one way or the other, we will not stop to consider whether it will add the ·00065° or take it away, as no man living other than Mr. Donaldson desires to know, and he would still maintain that the error amounts to ·27°.

Argument No. 3.—Therefore Mr. Donaldson does not understand how the value of the equation (32) is affected by variations in the value of the second term within the brackets, and he ought to take lessons either in reticence or in arithmetic, and not come before the public a-wondering why one-half per cent on $\frac{k}{\pi v_o}$ is unimportant, while one-twentieth of one per cent. in t_o is worth all the trouble of the porous plug experiments.

Fact No. 4.—He says, "I said that in the course of my researches I had met with many amazing statements, but none so amazing as the statement that $\pi \frac{d t}{d p}$ is a constant negative abstract number." This is a ——.

Reason No. 4.—Because it was $\pi \frac{\delta t}{\delta p}$ he wrote about in that sense on page 54 of the *Engineer*. We told him that he believed he had quite a different cat in the bag, and now he falsifies his statement by writing $\pi \frac{d t}{d p}$, which is his own expression, and never was used by Thomson.

Argument No. 4.—Since Sir Wm. Thomson, in the article criticised by Mr. Donaldson, has stated that the symbol, δt, is "the cooling effect (reckoned negative when the effect is rise of temperature), as measured by Joule's thermometer," and the use of δt is solely in connection with the porous plug experiment, Mr. Donaldson, who says he has "recently read the article," must either be deceiving himself or imposing upon us if he tells us that he is amazed that $\pi \frac{\delta t}{\delta p}$ is a constant negative number. If he understands algebraic notation and the definition of δt, he ought to know that $-\pi \frac{\delta t}{\delta p}$ is a positive number, and $\pi \frac{\delta t}{\delta p}$ is a negative number, if t and p arithmetically increase together or decrease together.

We therefore leave Mr. Donaldson before this dilemma—either he thinks he has read the article but cannot make out what it is all about, or he has read it and understands it but is wilfully misrepresenting it. Let him say which horn he chooses.

In his concluding paragraph he comes on with another cat, $\frac{d t}{d p}$—a Manx one this time—and he strokes its back quite familiarly, pretending that he never did have any other favourite. Alas! for poor $\pi \frac{\delta t}{\delta p}$ of Sir William Thomson's article, it has come to a sad end we fear. Mr. Donaldson has smothered it.

His last words are, "under no possible conditions can a gas expand without doing work." He does not seem to understand that a gas may expand into a vacuum, and during that expansion there is no more expenditure of energy than there is expenditure of money when one shakes the loose change there is in his pocket.

We have numbered our "facts, reasons, and arguments," for the convenience of Mr. Donaldson.

SCIENTIFIC DREAMS OF THE PAST.

SINCE the announcement of Edison's latest application of electricity a chorus of voices has arisen, the burden of which is, "I thought of it," and it seems as though these would-be famous ones were desirous of claiming the credit of what the American inventor has brought to a more or less practical issue, simply because in one of those flights of fancy to which we are all subject the idea has floated hazily before the mind. This is of course the old story. Many of the inventions which are the glory of our time were foreseen after a fashion by dreamers, in whose imaginations they received a kind of virtual existence.

The electric telegraph is foreshadowed by Strada in some twenty verses of his *Prolusiones Academicae*, which were published in Rome in 1617. To him it was a fancy, a simple wish :—

> O ! utinam haec ratio scribendi prodeat usu
> Cantior et citior properaret epistola !

The manner in which he understood the instrument was reproduced by all the students of the time, notably by a Jesuit of Lorraine, Père Leurechon, in his *Hilaria Mathematica*, published in 1624.

In a paper upon this subject Albert de Rochas gives an account of many of these "foreshadowings." Not only the electric telegraph but the phonograph, the microbes, aerial navigation, photography in natural colours, Lord Lytton's "Vril" and Madame Blavatsky's cult seem all to have been anticipated in the fancy of the old dreamers. These are described by de Rochas in a recent number of the *Revue Scientifique* (Paris).

In speaking of the electric telegraph the writer quotes a passage, in which it is mentioned, from the French translation of the *Hilaria Mathematica*, published in 1626, at Pont à Musson, under the title *Récréations Mathématiques*, by an author who signs himself Van Etten.

"There are some who have intimated that absent persons might be able to converse by means of magnets or some similar stone. For example, Claude being in Paris and John in Rome, if each had a needle rubbed on some stone the property of which was such that as one of the needles moved in Paris the other would move in Rome, it might be that Claude and John would both have a common alphabet, and that if they agreed to speak from a distance every day at six o'clock in the evening, arranging that the needle should make three turns and a-half as a signal that it was Claude, and no other that wished to speak with John. Then Claude, wishing to tell him that the King is in Paris (le roy est à Paris), will move his needle and stop it at L, then at E, and then at R, O, Y, and so on with the others. At the same time, John's needle acting in correspondence with Claude's, will move and stop at the same letters, so that it will be easy for it to write and make understood what the other means."

Of course, the whole thing was a chimera, and as a present day criticism we cannot do better than quote the remark of the old Père Leurechon: "The invention is very nice, but I do not believe there is a magnet in the world that has such virtues."

And so these dreams are repeated, to receive, perhaps, possible verifications in future discoveries; and thus old follies may, as Beaumarchais says in the *Marriage de Figaro*, become wisdom, "and the fictions of the ancients be transformed into pretty little truths."

A Probable Relationship between Specific Inductive Capacity and the latent heat of vaporisation.

THE question whether the specific inductive capacity and the latent heat of vaporisation of a liquid are in any way related to each other, has just been investigated by Dr. Eugene Obach. Although the experimental data which can be brought forward in support of a relationship between physical constants hitherto considered independent of each other, are somewhat meagre and not particularly accurate there is reason for believing that a relationship does exist. Dr. Obach states that as far as his experiments upon certain series of chemically related organic compounds are concerned there is evidence in favour of the specific inductive capacity, and the latent heat being directly proportional. Considerable difficulties were experienced during the investigation owing to the fact that the numerical values of these two physical constants obtained by different observers are in many cases very discordant. There is evidently room for more work in this direction. Dr. Obach contributes a long article to the *Philosophical Magazine* (July issue) on this interesting subject, which, although incomplete, he hopes will induce others to take it up and pursue it in a systematic and exhaustive manner.

An Ideal Telephone.

IN speaking of the future prospects of telephony in a lecture on the possibilities of applied science, which is reported in the July issue of the *Journal of the Franklin Institute*, Mr. Oberlin Smith indulged in what he said the practical electrician would term "the rhapsody of an enthusiast." The ideal telephone would, of course, be international, and its current as good a voice transmitter by ocean as by land. We must look to science to cure it of its *mal de mer*, and to make it perform its functions on land so that a part of the conversation will, at least, consist of something else but "hellos." It must be so good that no sound can be heard but the voices of the two individuals who happen to be using it, and so cheap that it can be in every house having any pretensions to affording the ordinary decencies of life. The exchange system should be such that any user can at once put himself in communication with any desired correspondent in any part of the civilised world! And may this not happen while others are using the same wire and without interference? Mr. Smith truly says that stranger things than this have already happened, and there is no knowing what brilliant results may be achieved as we follow out the general principle of running different kinds and phases of currents through the same wire at the same time. The embodiment of this principle has already made famous an Edison, by the invention of quadruplex telegraphy. It has enabled us to send an "induced message" in train-telegraphing over a wire through which ordinary messages are passing at the same time by it; a Gray sends a "dozen musical tones of different pitches through a wire in which they do not get mixed up at all." Restless inventors on the look out for ideas upon which to employ their excess of energy cannot do better than read this suggestive lecture by Mr. Oberlin Smith, for although he indulges in some wild flights of fancy (as, for instance, when he suggests that we may learn to make any metallic structure as we may desire, either great or small, in one piece complete by a process of electro-deposition!), there is plenty of food for earnest thought.

A Curious Litigation.

THE development of the applications of electricity have given rise in the United States to a curious litigation, and if the decision of the tribunal before which the case was heard is not reversed, it may serve as a basis for new legislation all over the world. It is well known that in many electric installations the earth is employed as a "return wire," contact being made to earth at the two end stations by means of earth plates; this fact was discovered by Steinheil, at Munich, in 1837. Now it seems that telephone lines in some districts suffer considerable disturbances on account of this practice, and the Supreme Court of Ohio has been called upon to decide between two litigants as to the right to make use of the earth as a return wire to the detriment of other installations. Of course, it was pleaded that the earth was common property and that anyone might make use of it in this way; and it was also argued that there would be great expense entailed if a complete metallic circuit were insisted upon. The court, however, decided that no one has the right to make use of the earth for the return of the current to the detriment of other electrical installations, although, we believe, that in other instances the decision has been quite to the contrary. In connection with this we may recall the fact that the growth of the applications of electricity in London and its neighbourhood and the consequent increase in the practice of using the earth as a "return wire" has seriously affected some of the instruments at the Royal Observatory, especially the needles of the galvanometers used in studying the variations of terrestrial magnetism. The use of "earth" seems also likely to play an important part in the lawsuit which is to test the validity of the Lane-Fox patents.

The System of the Société Française des Télégraphes Sous-Marins.

Mr. W. SHARPEY SEATON'S announcement of the completion of the cables which extend the system of the Société Française des Télégraphes Sous-Marins through the West Indies and along the coasts of the Guianas to Brazil awakens memories that have slumbered for sixteen years. What, in the meantime, has become of the sword-fish and saw-fish that ruined the cable that was laid between Para, Cayenne and Demerara in 1874-5. Have they changed their habitat or altered their tastes, or has the Société Française found a way to defy them? We incline to think the last solution the true one; and we admire the courage of our neighbours that has not been daunted by the disastrous experiences of the Central American and West India and Panama Companies. It is a significant fact that, while the latter company has been keeping two repairing ships constantly at work, the French company has for nearly four years been working their original system of a thousand miles of cable with its ten landings without a single interruption, except that one of only eleven hours duration, which was caused purposely, when the Mole S. Nicolas-Puerto Plata cable was raised off Cape Hayti in 500 fathoms and connected to two cables extending to the Port. Luck may enter for her share in a success, but the main part is generally due to skill, experience and hard work. The directors of the Société Générale des Téléphones are to be congratulated on their sagacity in having secured Mr. Seaton for a partner in this important undertaking which has been achieved with signal success.

ELECTROSTATIC INDUCTION.

BY J. E. TAYLOR.

(*Concluded from page* 138.)

THESE lines are shown as curves. This curvature would partially arise from the velocity of the transmission of strain

FIG. 15.

through the dielectric being different to that in the conductor. Whatever the amount of curvature may be however, even if it were the other way about, would make no difference to the strength of the current, which would still be uniform at all parts of the circuit. One or two facts which would very probably cause a difference of speed of propagation are: first, the resistance which may be defined as the reciprocal of the rate of collapse of strain in conductors (*i.e.*, the reciprocal of a velocity); secondly, self-induction, whereby more or less of the static energy is absorbed in producing the magnetic field; thirdly, the probability of conductors having an instantaneous specific inductive capacity.

The laws of lines of strain before given, enable the static field of various conditions of circuits to be mapped out, and with a little development no doubt all dynamic and magnetic effects can be easily explained, besides leading the way to a true conception of the nature of matter and of the ether. In the case of rapidly moving strain the lines need not, of course, be normal to the surfaces from which they emanate. Fig. 16 will give some idea of the distribution of strain in a

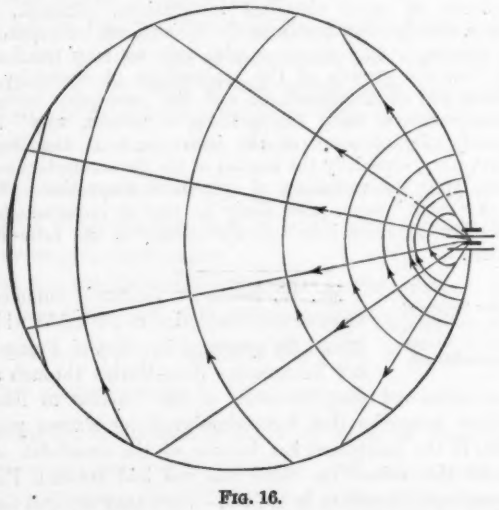

FIG. 16.

circular circuit, and it shows also the energy paths from source to conductor. This figure also shows that the supply of energy to all parts of the circuits is the same, for the radial energy lines should divide the circuit into equal lengths.

The propagation of the strain along the conductors may be regarded strictly in accordance with law No. 6, as follows:—

Let A B be a part of a circuit in which a steady current is flowing. Suppose a line of strain to emanate from the point, B. This point, B, being thus electrified, possesses the power of propagating lines of strain. Suppose it to propagate one emerging from the conductor, as 2; then that part of this second line in the conductor rapidly collapses, leaving the second point of emergence electrified, which then propagates in a similar manner to another point, 3, in front, and so on.

From fig. 17 it is also evident that for instantaneous currents only the very outside portion of the conductor is made use of.

Electrical Radiation.—At the root of the phenomenon of electrical radiation lies another recent scientific discovery, that of electrical oscillations. One of the primary effects of these oscillations may very conveniently be tried as follows:—Let C and C′, fig. 18, be two condensers in series attached to an influence machine in the usual manner. If a pair of sparking rods be connected, as shown, to any part of the outside circuit, sparks may readily be obtained between these

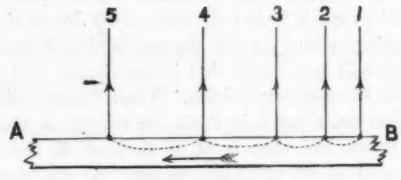

FIG. 17.

rods, whenever a discharge occurs between the terminals of the machine, provided these sparking rods are not separated beyond a certain critical distance. And, however short the length of outside circuit thus "tapped" may be, it is impossible to entirely eliminate these sparks. Their striking distance is such as to require a much greater difference of potentials than would be calculated by Ohm's law, and, moreover, by making any given length of wire into a helix or spiral the length of spark obtainable from its ends is greatly increased. By making a helix of a conductor we certainly do not increase its true resistance and there is only one thing which we do alter, and that is, the magnetising power of the conductor. In other words, we increase its self-induction. It must be, therefore, the self-induction of the conductor which regulates the sparking

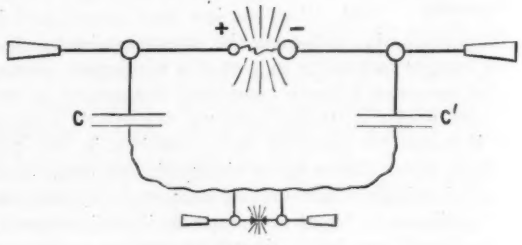

FIG. 18.

alluded to, more than the resistance. Now, self-induction only affects currents varying in strength, and from this experiment alone we might guess that the discharge is oscillatory in character. The numerous and beautiful experiments of Dr. Lodge conclusively prove that the discharge of a condenser under normal conditions causes enormously rapid reversals of current in the discharging circuit. The frequency of these reversals is decreased by increasing the capacity of the condenser, or by increasing the self-induction of the discharging circuit, whilst the total number of reversals is determined by the resistance of the circuit. Now magnetism is certainly analogous to a spin of some kind in the ether, and is so connected with electrostatic strain that whenever such strain is forming it causes a spin in the ether, such spin constituting the magnetic field, the axis of rotation being at right angles to the direction of strain displacement, and each at right angles to the direction of propagation of the strain. Magnetism, thus inseparably connected with static strain, may be regarded as the "load" set in motion during a displacement. The oscillations of a discharge are caused by the sudden release of the strain, which sets the magnetic load in motion, the kinetic energy of the load then carrying the strain beyond the neutral point, and thus reversing its direction, when a similar process goes on over again, the energy continually changing from potential to kinetic, and *vice-versa*, until it expends itself in other ways. The dielectric around and in a Leyden jar or other condenser discharging under suitable conditions, is thus thrown into a state of intense molecular vibration by the agency of the ether. Or, the lines of strain joining the coatings are rapidly reversing in direction, all, however, having the same direction at the same instant of time. Now, a charged condenser has curved lines

of strain connecting its coatings, which may extend far out into space, decreasing in intensity as the square of the distance from the condenser. On discharging the condenser, these lines come back (as they went out) with the velocity of light, and as they contract they continually reverse in direction, producing electrostatic or electro-magnetic waves, which are one and the same thing. The wave length so produced is determined by the velocity of propagation divided by the frequency of oscillation, and if this quotient be made about a hundred thousandth of an inch, by making the rate of oscillation enormously great, we have what are called light radiations.

According to Dr. Lodge, a tiny thimble-sized Leyden jar discharging through minimum self-induction has a frequency which gives a wave length of about 2 or 3 feet. If the above explanation be correct it will be seen that the waves produced by discharging a Leyden jar have not an outward but an inward motion, and also that the whole strain along the length of any one line is set in motion probably instantaneously. At any rate the propagation along the length of a line is practically infinite compared with the velocity of 185,000 miles per second. The effect of *gravitation* in the same comparison is also transmitted practically instantaneously.

By the use of an induction coil it is easy to produce outward going waves and it was these which Hertz used in his well-known experiments in which he showed that these waves were capable of reflection, refraction, and interference, just as waves of light are. Waves of different lengths have varying properties all the way up the scale, thus moderate wave lengths pass almost unaffected through a brick wall, whereas light waves may be totally quenched by a piece of paper. The phenomena of reflection, refraction, &c., yet await a more complete elucidation as also does the production of *shadows* which are, perhaps, only connected with the smaller waves. Electrical radiations thus considered may well, under certain conditions, be the cause of earth currents, aurora borealis, and variations of magnetic force. In the years to come the theory of light itself will very probably be greatly advanced by our knowledge of the nature of the radiation.

The nature of the strain appears to be analogous to a force tending to separate the atoms of the molecules of a substance further from one another in the direction of the lines of strain, for the vibrations in light being at right angles to the direction of propagation it is probable that the displacement is along the lines. In electrolysis the atoms actually are separated and gases are decomposed by the passage of a spark. Many facts point to a dual nature about this strain, and, indeed, it is difficult to conceive how such a strain could tend to pull the atoms apart, unless there are two forces in opposite directions. Ether is absolutely essential to any attempt at explanation, and the existence of some such substance cannot be doubted.

When strain collapses in conductors it sets the particles in vibration, the equivalent energy being thus evolved as heat and, perhaps, light. The method of setting up this heat vibration is probably somewhat analogous to the setting up of heat and light vibrations by the passage of an electric spark through gases, in which case, thanks mainly to Prof. Crookes for his brilliant researches in this particular direction, we know that they are set up by collisions and impact against the electrodes of the molecules of the gas in which the spark takes place. Beyond this, however, all is still speculation, but the time is probably not far distant when we shall become intimately acquainted with the construction of matter and the various mysteries of atomic forces shall be unravelled.

The theory of electrostatic induction will, no doubt, when its value is fully recognised, take a position of much greater importance than it has hitherto occupied, for now we recognise that electrical science can, strictly speaking, only be divided into two parts, electrical strain and magnetism.

The application of lines of strain acting under definite laws, to the theoretical consideration of the many various branches of electrical science, must elucidate many points, and possibly lead the way to new applications of the science.

In conclusion, it may perhaps be as well to state that there are one or two points in the substance of these articles which are at variance with some generally accepted theoretical deductions. These points, however, await more complete experimental verification, and will be brought forward in due course.

THE SOLUBILITY OF ELECTROLYTES AND NON-ELECTROLYTES.

THE process of dissolution is regarded by W. Nernst as being similar to that of vaporisation, the molecules assuming in both cases the gaseous state, in the one under the action of osmotic pressure, in the other under that of vapour-tension.

If the hypothesis of Van't Hoff be allowed, it may be demonstrated that the work which must be expended in converting a gramme-molecule of a salt into gas is exactly equal to that required in order to bring the same amount of the same salt into solution. This expenditure of work is constant for all substances, and hence it appears that the specific attraction between the salt and the solvent (which has hitherto been assumed), does not exist, but that the process of dissolution is independent of such influences and is similar in all cases.

When a vapour diffuses into an atmosphere of any gas which is incapable of acting chemically upon it, its behaviour is as though it were being distributed in a vacuum. In the same manner the solubility of a salt is not affected by the presence of a second salt in the solvent provided that the two are without chemical action upon each other.

Horstmann has shown, however, that in the case of a dissociated vapour, the addition of either of the products of the dissociation will bring about an increase in the dissociation tension of that product; this results in a recombination and separation of a portion of the original substance. An indifferent gas is incapable of producing this effect.

In the same way, the addition of either of the ions to an electrolyte in solution may be compared to the case of a dissociated vapour. This, according to Nernst, may be readily proved. For example, the addition of a concentrated solution of potassium chloride or of potassium hydroxide, or of sodium chlorate to a solution of potassium chlorate, immediately causes a separation of some of the latter salt, this being due in the one case to the presence of an excess of the positive, in the other to an excess of the negative ions. The amount of solid salt thus separated by the addition of a definite quantity of a second salt containing one of its ions, can be calculated from the dissociation theory, and Nernst, in the *Zeit. Physikal. Chem.*, iv., p. 372, shows the agreement between the calculated and observed quantities in the case of silver acetate.

Although many experimental data exist with reference to the influence on the solubility of a substance in water exercised by the presence of a third substance, no generalisations have up to the present been effected, with the exception of the laws which Nernst believes to hold good in the case of electrolytes.

In accordance with the deductions of Nernst, if the third substance is not an electrolyte, it should be incapable of influencing the solubility, and should itself dissolve in an aqueous solution just as it would do if thrown into pure water. Hence the solubility of a substance in water should be in no way altered by the addition, say, of alcohol to water, provided that the substance itself is quite insoluble in alcohol.

Now the truth of this conclusion has recently been examined by G. Bodländer, who contributes a paper to the *Zeitschrift für Physikalische Chemie* (*vide* vii., p. 308), and it seems that experiments on the solubility of a number of substances, both electrolytes and non-electrolytes, in mixtures of alcohol and water go to prove that it is untenable.

Suppose that 100 cc. of the alcoholic solution contain s grammes of a substance dissolved in it, and that the amount of water present be w grammes; and suppose it to be true that the alcohol exercises no influence whatever upon the solubility, then the proportion of the dissolved substance to the water, viz., $\frac{s}{w}$, should remain constant, whatever variation takes place in the amount of alcohol present. But it has been found by experiment in all cases that as the amount of alcohol is increased the ratio $\frac{s}{w}$ decreases, so that water which contains alcohol in solution will not dissolve any third substance to the same extent as pure water, and the solubility will decrease as the amount of alcohol present increases.

Now we may make two assumptions with reference to this behaviour, namely:

a. A given amount of water may be made to dissolve a

certain amount only of alcohol or of any other substance, but not the two together, so that if to a saturated solution of the one a quantity of the other be added, the water will be divided between the two, to the exclusion of a certain portion of the substance which it originally held in solution.

b. The addition of alcohol to water effects a decrease in its solvent action on other substances comparable with the reduction which it effects in the freezing point.

Either the one or the other of these assumptions may obviously be made, but as far as the deductions which they involve are concerned, Bodländer is of opinion that in all the cases studied neither appears to hold good. If these are disposed of, then the only explanation remaining of the influence exercised by the alcohol is that it is a purely mechanical one, and is due simply to the dilution, as it were, of the water, and its consequent distribution over a larger space.

Certain theoretical considerations have moreover led to the conclusion that if this is the case in saturated solutions of a substance in water containing different amounts of alcohol, the ratio of the amount of water, W, to the cube root of the amount of the dissolved substance, $\sqrt[3]{S}$, should be approximately constant. This relation is, as a matter of fact, found to hold experimentally in the instances which have been quoted.

The experimental data given by Bodländer include the solubility of sugar, potassium chloride, sodium chloride, potassium nitrate, sodium nitrate, and ammonium sulphate. In all these cases the ratio

$$\frac{W}{\sqrt[3]{S}}$$

is approximately constant

In the case of the chloride of potassium and the nitrates of potassium and sodium the values at first slightly increase with increasing amounts of alcohol, and then they are subject to a decrease; this behaviour may be due to changes of a dissociative or associative nature.

With chloride of sodium it was noticed that there was a marked increase in the values of the ratio throughout, with increasing amounts of alcohol. But if the assumption is made of the existence of a hydrate, NaCl, 2 H_2 O, and the results be calculated upon this basis, the values so obtained are perfectly similar in character to those with the other salts.

In another paper on the solubility of mixed salts in water, Bodländer investigated the effect produced on the solubility of one salt by the addition of another, and observed that the solubility is diminished in such a way that the quotient of water present in the solution by the cube root of the quantity of original salt is approximately constant. The number obtained with sodium chloride added to sodium nitrate solution appears to give confirmation to the view that the chloride exists as NaCl, 2 H_2 O.

Difficulties were experienced in the case of ammonium sulphate owing to the separation of alcoholic solutions of this salt into layers, but by considering the upper and lower layers in each case separately normal results were obtained.

FURTHER RESEARCHES ON THE BEHAVIOUR OF BISMUTH IN THE MAGNETIC FIELD.

IN our issue for December 5th, 1890, we gave some account of Mons. A. Leduc's investigations upon the electrical resistance of bismuth in a magnetic field. He specially addressed himself to the problem of determining mathematical formulæ by means of which it would be possible to calculate the resistance

$$R_M,$$

of a wire of bismuth placed in a magnetic field of value, M, and at a temperature, $t°$, in terms of its resistance, R_0 at 0°, outside the field. Four equations were found from which the resistance may be calculated within certain limits of temperature, and it was observed that the influence of magnetism vanishes at the fusing point of the metal.

Within the last few weeks P. Drude and W. Nernst have been examining into the influence of temperature and the state of aggregation on the behaviour of bismuth in the magnetic field.

They observed that the so-called "Hall" phenomenon of the rotation of the equipotential lines by a galvanic current in the case of bismuth is less marked at a temperature just below the melting point than at the ordinary temperature.

When the temperature was raised above that of the melting point, the "Hall" effect is so very slight that it is scarcely measurable.

The bismuth was allowed to solidify and cool down again, and then again examined, when it was found that it did not return exactly to its initial condition as measured by the "Hall" effect.

Leduc found that the influence of temperature diminishes slightly as the intensity of the magnetic field is increased, and it was observed by Drude and Nernst that as the temperature rises the increase in the resistance of the bismuth in the magnetic field also becomes smaller. The increase in this case already becomes very slight at a temperature much below that at which bismuth melts.

Any change of temperature that is sufficiently marked appears to have an effect upon the initial resistance of bismuth, for on heating the metal and then allowing it to cool down to the original temperature at which the resistance was measured, a variation in the resistance is plainly evident.

Some other metals besides bismuth were examined in the same way and with similar results. In the case of antimony the effect of change of temperature was, however, far less marked. The "Hall" effect could not be measured in the case of mercury, and although a distinct increase of resistance was noticed, the influence of temperature was not ascertained.

Bismuth, as far as could be ascertained, appears to undergo no change in its optical properties when placed in a magnetic field.

A full account of these experiments is given in the *Annalen der Physik und Chemie*, series [2], No. xlii., pp. 568—580.

EDISON LAMP CASE.—AN OPINION.

OUR contemporary, *Industries*, in an article on the above case, states that it presumes the judgment recently given in America corresponds to the English judgment in the Court of Chancery, and that an appeal will be made to higher court.

The American specification may be said to be almost exactly the same as our English one, and the judgment, which is in Edison's favour, also resembles the appeal judgment here. The matter, however, has been more fully dealt with. We have always to take two views of a specification—the legal and the technical. We ourselves, of course, favour the technical view, and believe it very improbable that patent matters will be justly and satisfactorily dealt with until there are special judges to look after them. We think that any unprejudiced electrician would conclude after reading Edison's specification that the idea was to make a lamp of high resistance, to be used on high pressure parallel circuits. In the first part of Judge Wallace's judgment he keeps this clearly in view, but he, later on, seems to get confused, like the English courts, by speaking as if an unpractical lamp may be made practical by invention of the "filament." It seems that the legal idea is, that people had tried thick pieces of carbon, but failed to make good lamps; but Edison himself says, "A thin piece of carbon looks as if it would make a still worse lamp, but it does not; it converts a failure into a success." To be more explicit, we mean that a filament is worse in a lamp than a rod, and therefore is no improvement. When we consider a system of distribution, however, it becomes a necessary evil, and the disadvantages of using a thin fragile thread instead of a strong durable rod are quite counter-balanced by the advantages of using comparatively small mains in distribution. Anent this, it is curious to notice that Edison was himself aware that a thick conductor was better if other things were equal, and that he realised that the longer and thinner the thread is made, the weaker it is. He clearly shows by his propositions to embody such materials as oxide of zinc for increasing the specific resistance and to coil the thread to expose merely a portion of the surface. Thus if we replace a filament of horseshoe shape by one of the same surface and resistance made of material containing double the specific resistance, the new filament is less than three-quarters of the length of the old

one, and in diameter 20 per cent. larger, and the deflecting weight necessary to break it when suspended at the end is now nearly two and a half times that required to destroy the original filament.

The most surprising part of the case is the assumption that Edison invented modern lamps simply because he described a filament in his specification, and filaments have since been adopted for use generally. Suppose now that a patentee gets out the leading points in a problem which has to be solved, and this problem is afterwards cleared up by others; should all the credit and benefits be given to the patentee who merely produced the difficulties for others to overcome? Everyone understanding the manufacture of incandescent lamps knows that success is entirely dependent on attention to a host of numerous difficult points which Edison never thought of.

It is uncertain how the electrical industry will be affected by this decision, but we think the results may be possibly more serious than here. In England anyone can purchase the lamps, but in America the Edison Companies being central station contractors may refuse to supply lamps without other plant.

THE OSBO-PREMIER BATTERY.

THIS battery is stated to have been specially designed for small electric light installations up to 30—40 lamps where the dynamo and engine would be unsuitable for various reasons.

The cell is of the single fluid type of carbon and zinc, but contains a re-oxydising apparatus for re-oxydising the special depolariser (that becomes reduced in the working of the cell by nascent hydrogen).

The figs. show the arrangement of the battery. A (fig. 1) is the cell, B and C the elements, D a porous tube with perforated bottom, E. This porous tube is tightly packed with

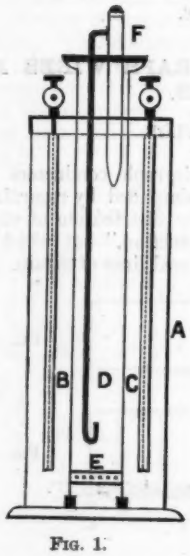

FIG. 1.

FIG. 2.

the depolariser, the latter only requiring renewal every six to nine months.

In the upper part of the porous tube is a glass tube, F, fig. 2 (shown on an enlarged scale by fig. 2), with a side pipe, 3, and glass stopper, 2; the side tube goes down into the depolariser itself. When to be used a re-oxydising bag is put in the tube, F, with the addition of a little water, and the tube closed by the stopper. A chemical action is thereby set up which results in the liberation of oxygen, which flows through the pipe, 3, into the depolariser, re-oxidising that which has been reduced.

The re-oxydising bag contains a special mixture of chloride of lime with a few crystals of nitrate of nickel; this in the presence of water or moisture disengages oxygen (this more especially when warmed). The battery solution provides for this heat in consequence of the chemical action taking place.

There is stated to be no action on open circuit with the solution, as the zincs are heavily amalgamated, neither is there any smell or fumes.

The 12-cell set (size, 24 inches × 18 inches × 10 inches; weight, 15 lbs.), it is stated, runs 30 hours constant, yielding an output of 14 ampères at 24 volts at a consumption of 30 lbs. zinc and 2½ lbs. depolariser (3 ozs. per cell) and 2 dozen re-oxydising bags. We thus have—

14 ampères × 24 volts × 30 hours = 10,080 watt hours,

or, practically speaking, 10 Board of Trade units at a cost of—

	s.	d.
30 lbs. zinc, at 2½d.	5	7½
2½ lbs. depolariser at 5d.	0	11¼
2 dozen re-oxydising bags at 2½d. ...	0	5
	6	11¾

7s. ÷ 10 = 8¼d. per B.T. unit.

The cost of electrical energy becomes 8¼d. per Board of Trade unit inclusive of all, with the exception of labour, which is almost nil.

Such is the description of the new battery, of the performance of which only a bare statement is given. The public may be induced to accept the statement as all sufficient, but experts would (or ought to) prefer to have plain figures giving the results of actual runs, *i.e.*, figures showing E.M.F. of battery on open and closed circuit from the commencement of a run to the termination of the same, readings being taken at intervals of say 1 hour, and the measured weights of zincs at commencement and end of run. If this were done we imagine that the flowery statement would require considerable modification. The following calculation is instructive:—

A current of 1 ampère for 1 hour in any primary battery will dissolve 18·72 grains of zinc in each cell, provided there is no local action. Therefore, a battery giving 30 ampères for 14 hours should dissolve in each cell

$$\frac{18{\cdot}72 \times 30 \times 14}{7{,}000} = 1{\cdot}1232 \text{ lbs.}$$

or

$$1{\cdot}1232 \times 12 = 13{\cdot}478 \text{ lbs. in 12 cells.}$$

The new battery is stated to consume *30 lbs.*, that is 123 per cent. more than the theoretical amount, a result hardly consistent with the statement that there is "no action on open circuit." We should like an experiment made with twelve cells all in series, six fitted with the depolariser tube, and six without, and then accurate measurements of the E.M.F. of each cell taken from time to time during a run. In the absence of such a test as this, and the beforementioned, we hesitate to accept the statements of Messrs. Clark and Montigue (the agents for the new battery) that the battery "supplies the long felt want of the electrical profession."

KENNEDY'S ELECTRIC LAMPS WITHOUT A FILAMENT.

BY R. KENNEDY.

IN a series of experiments during the years 1881 and 1882, researching the properties of alternating currents and induction coils, some experiments were made with highly exhausted tubes and bulbs having two platinum wires entering as conductors, different currents and pressures of electricity being used to produce discharges through the vacuum; it was observed frequently that with high pressures from an induction coil giving a current with a frequency of about 150 ∼ second, and a pressure which could be varied from 1,000 to 10,000 volts, we could raise the temperature of the platinum points entering the exhausted bulbs or tubes, so high that they fused. The noticing of this effect led to the construction of the lamp shown in fig. 1 (this figure is taken from a Patent Specification 4,752 of 1882).

The pencil-shaped conductor was a piece of Carre carbon, about 2 mm. diameter, such as was then used in Joel's semi-incandescent lamps, the other conductor was a button of carbon; both conductors were heated, when the current at high pressure from the induction coil was turned, and with

about 7,000 to 8,000 volts the pencil rose to a temperature sufficient to melt the platinum wire to which it was attached, there was no appearance of anything like an arc, the pencil heated up uniformly all over, the button heated also, but its large mass prevented a great rise in temperature.

FIG. 1.

Figs. 2 and 3 are a plan and elevation of another lamp, from same specification; here, two extremely light plates were used, and the wires coated with insulating materials up to the point of contact with the plates.

The plates first used were made by carbonising thin vegetable parchment paper. This lamp was better than the first, due to the smaller mass of the plates—they could be kept glowing—while the conductivity of the platinum for heat kept down the temperature at the points of contact, *b*, *d*.

FIG. 2.

FIG. 3.

This lamp also ended by the platinum wires, *b*, *d*, fusing close to the plates, when the coil was turned on with all the pressure at command.

Figs. 4 and 5 are a side and edge view, respectively, of another lamp; and fig. 6 is a view of another with spiral conductors, *h*, *h*. In all of these lamps carbon was used, and good effects obtained, the carbon glowing intensely, while the fusion of the platinum was not readily brought about.

Similarly constructed lamps were made with infusible oxides and mixtures, but carbon gave the best results, its only objectionable feature noted being the blackening of the bulbs, just as had been found with ordinary filament lamps.

The dynamo used was a Siemens Brothers' alternator, and a step up induction coil about 12 to 1 ratio. A mercury pump of improved Geissler make was used for the vacuum making.

In all cases we used low frequency, 150 ∼ per second, and to prevent the current at high pressure discharging round the bulb from wire to wire outside, the wires were always entered from opposite sides.

I obtained my light in these lamps with high pressure and low frequency. M. Tesla obtains his light by using high frequency and high pressure combined.

I think some experiments were made in this direction by Mr. J. E. H. Gordon, and that he had a patent for a lamp worked by high pressure electrical discharges in a vacuum. I have not the number and date,* but remember having my attention called to it when my experiments were going on.

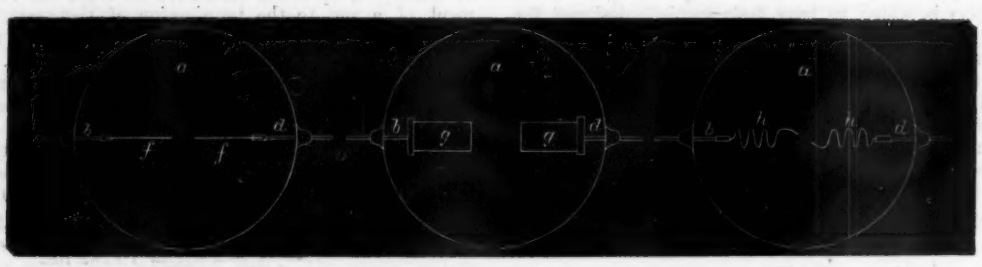

FIG. 5. FIG. 4. FIG. 6.

CAPACITIES OF TELEGRAPH WIRES AND CABLES.

BY J. E. TAYLOR.

THE theory of capacities of telegraph conductors under various conditions may be much simplified by regarding the matter from a consideration of the distribution of what are generally called the "lines of induction," but which may, perhaps, be more appropriately termed lines of strain.

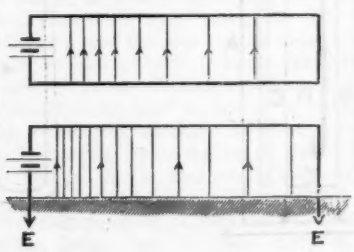

FIG. 1.

FIG. 2.

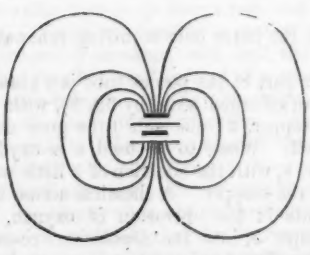

FIG. 3.

At any instant of time the charges on a return system of overhead wires may be depicted by straight lines running directly through the intervening dielectric, as in fig 1.

* For description see ELECTRICAL REVIEW, Dec. 1st, 1880.—EDS. ELEC. REV.

These lines are not (at least in general) straight, but they are more simply considered thus.

In the same way the case of a single overhead wire may be represented as in fig. 2. The lines of strain are simply parts of the lines which extend from pole to pole of every galvanic battery, being the strain in the intervening dielectric. Thus the external electrostatic field of a battery might be represented as in fig. 3.

The case of two looped cables through which a current is flowing is represented in fig. 4, and fig. 5 represents a single

Fig. 4.

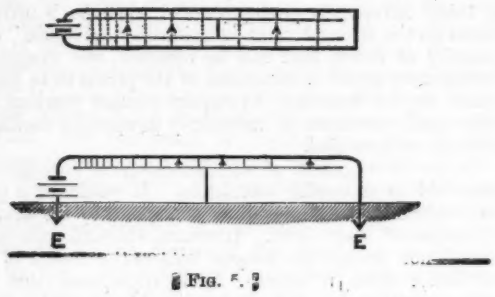

Fig. 5.

cable earth connected. In all cases the number of lines of strain is proportional to the E.M.F. of the battery and to the thinness of dielectric, that is, to the shortness of the lines. In fig. 4 the lines of strain are short circuited through the sheathings and water, those in one cable being simply the continuations of those in the other. It is thus readily seen that the capacity of the looped cables is exactly half that of the single earth-connected cable in fig. 5, for the length of the lines or columns is exactly doubled, and the average sectional area of each must therefore be doubled, for the same difference of potentials is maintained between their terminations. The number of lines, and therefore the capacity, is thus halved. The overhead lines of figs. 1 and 2 differ in no *essential* respect from these cables; but from a consideration of the distribution of the lines of strain in the two cases, as shown in transverse section in figs 6 and 7, it is

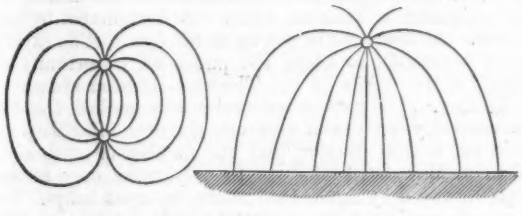

Fig. 6. Fig. 7.

evident that since the expression $\frac{l}{a}$ (which represents the difference of potentials), where l is the length of any one line or column and a its average sectional area, must be the same in both cases, and that l is not doubled in the second case, the theory is a little more complicated. In fig. 7, l is large and a is also very large; and in fig. 6, although l is smaller, a is more than proportionally smaller owing to the lines having to converge at both terminations instead of only one as in fig. 7. The effect of this would be, that the number of lines in fig. 6 would be rather more than half that in fig. 7 for an ordinary case, that is, the capacity of the return system of overhead wires is rather more than half that of a single earth-connected wire.

This is entirely in accordance with experiment; M. Massin having recently made experiments with a view to determining exactly these capacities under certain stated conditions, when he found that the return system had about $\frac{7}{10}$ths the capacity of the single wire.

ELMORE COMPANIES AND WOULD-BE INVESTORS.

"I think I am right in advising would-be investors to take time by the forelock, and buy while they can do so at the present moderate price." With these words *Truth* concludes another article on the Elmore companies. It is so largely made up of the same material as that of the *Financial News* to which we referred in our issue of June 5th, that nearly all the comments we made then are applicable to *Truth's* article now. It is useless to repeat them. But there are also some new items of information to which we may refer for the benefit of the "would-be investor." *Truth* has paid its promised visit to the works, and is able to fully confirm the statements respecting the position and prospects of the company which it made a week ago—as might well be expected, considering that the writer expressed his confidence in such a result beforehand. "I have convinced myself that, at present, from three tons to four tons per week . . . . . are being turned out in a perfect condition." Let us compare this with information given to the shareholders by the chairman of the meeting just one year ago. "The whole of the 20 tons per week depositing plant is in process of completion, and the first section, capable of turning out five tons a week, has been satisfactorily at work for several weeks." If we are to take both these statements as accurate, the output now is from one to two tons less than it was a year ago. And all this time there has been an immense demand for the product. *Truth* has it "on Mr. W. Elmore's assurance, that orders for that quantity [20 tons per week], and, in fact, for five times the quantity, can be procured with the greatest ease." We need not be unreasonable. Time must be occupied in completing such methods of manufacture, and difficulties must arise to be surmounted. But no difficulties were contemplated by the inventors either in the prospectus or since. "Those interested in the manufacture" state to a day when the 20 ton output will commence, to a ton the probable demand, and to a penny the cost and profit.

Another new item of interest in *Truth's* article is the holding of the shares. "The great feature is the unbounded belief of those closely connected with the companies in their success. . . . . ten gentlemen who are directors of the Elmore Companies hold between them 26,000 shares in the English Company, Mr. William Elmore and his family 7,000 shares, the secretary 1,000 shares, and twenty of the personal friends and relations of the board 14,000 shares, or 48,000 shares in all—nearly two-thirds of the company's entire stock—firmly held by about thirty-six persons. In the French Elmore Company eleven Elmore directors and the secretary hold just upon 11,000 shares, and the holdings of thirty-seven friends of the board amount to over 28,000 shares, or about three-fifths of the company's entire issue. Both in the English and in the French companies there are, in addition to the above shareholders, a large number holding one or two hundred shares apiece, who are in one way or another well acquainted with the process, and were firm holders of their shares, even when they were as high as £8."

We should add that *Truth* has ascertained from the company's books that numerous repeat orders are being received, and that a contract for 150 tons of tubes per annum of a special kind has been entered into.

There are two stages in the progress of such companies which are fraught with danger to the public. The first is when they are invited to apply for shares. The second is after the shares have been allotted and the public is invited to buy them. In the latter case, comments on the part of well-informed journals are less usual than in the former case. We do not know how the distinction has arisen, but we recognise that the danger to the public is as great—if not greater—and we have no hesitation in going out of the beaten track in their protection.

The fact is—and it may as well be recognised plainly—the Elmore Companies have reached the second stage. Through the medium of various journals "information" on the Elmore process and prospects has been disseminated. We have selected the most prominent papers which have come to our notice. In the interest of the would-be investor we may see if some of the facts are capable of bearing a different complexion to that placed on them.

It will be noticed that both the journals we have cited

have received official information from the companies and the Elmore interest, and on the strength of it urge the public to invest. The information prompts the advice, and if circumstantial evidence is worth anything, the origin of both is the same. "Whoso sayeth 'Buy! Buy'!! hath he not goods to sell?" The companies whose hopes are brightest, according to their advocates, are the English and French. It is these two to which investors' attention is turned. Who are the largest holders in these two? Two-thirds in the one and three-fifths in the other are "firmly held" by those immediately interested and their friends. We do not know if the holdings referred to have been the same since the formation of the companies. It may reasonably be inferred so from the manner in which it is put forth. If so, it will be seen that the company which realised handsome profits from the sale of licenses and divided those profits, divided them in the proportion of two thirds to inside friends and one third to the outside public.

Truth would be performing a public service by setting any doubts on this point at rest. With its knowledge of the inventors, the directors, and other officials, their relatives and friends, it might let us know the proportion of inside and outside holders in the Foreign and Colonial, the Wire, and the Austro-Hungarian Companies. The promotion of sub-companies ceased with the last-named, on whose prospectus we felt compelled to comment so strongly. The French Company is a sub-company, and the inside holding is large. It would be of interest to know that the inside holding of the Wire and Austrian Companies shows a similar confidence in their prospects, for it will largely reduce the outside loss in the event of the anticipations held out not being realised, and as the Foreign and Colonial is a parent company which has received large sums from sub-companies, the public might also like to know whether these sums have been divided between insiders and outsiders in the same proportion as would appear to be the case with the English Company.

It was announced that the shares of the French company were largely over-subscribed. The possibility that three fifths of the applications came from interested persons is significant of something. The holding of the shares by interested persons is given as a proof of their unbounded belief in the success of the companies. That the shares have been firmly held must not be counted unto the holders for confidence unless they have had an opportunity to sell. That they did not sell, "even when they were as high as £8," need not necessarily imply a confidence in the manufacturing profit. It might be accounted for by a confidence, though perhaps misplaced, in the issue of more sub-companies.

In the same issue of *Truth* which contains the Elmore article there is another article on the duty of the State in relation to prospectuses, which is a creditable pronouncement, and with the general conclusions of which few will disagree. In the course of that article occur the following words: "a man who applies for shares in a company is fully aware that he incurs risks which are not incident to holding Consols. He does this with his eyes open, balancing the probability of high interest against the possibility of loss of capital." This applies to the first stage undoubtedly, but does not provide for the second stage. Unhappily, a man may have his eyes open and yet be unable to see. A little dust judiciously thrown may seriously impair his vision. Investors are reminded that the English Company holds the founders' shares in the Wire Company, which are entitled to half the profits after 20 per cent. has been paid on the ordinary shares. It seems to us that it would have been more material to remind investors that the Wire Company provided the cash for the 50 per cent. dividend of the English Company, that the amount represents to the Wire Company so much unproductive capital which may make a profit on founders' shares, a contingency too remote for serious mention now. When investors are informed that they can "go in" under more favourable terms than the original shareholders it seems to us that any alteration of conditions is deserving of passing mention. Original applicants for shares in the French Company did not "go in" with a mortgage on the entire undertaking, as is the case now, a mortgage necessitated by the extravagant payments for patents and given as security for a loan made by the same organisation to whom the extravagant payments were made.

When it is stated that a contract for 150 tons per annum has been entered into at the same time that figures suggesting a profit of £140 per ton are given, it should, we think, be stated whether the profit on the contract is expected to reach that figure, or a lesser sum. As the contract is a contract, we presume a sale price is stated.

If the other Elmore companies' shares are held in similar proportions to those above mentioned the outlook for the investing public is better than we had anticipated. Those holders may be presumed to have gone into them with their eyes open. Those who are not interested we would strongly advise to "balance the probability of high interest against the possibility of loss of capital." We see no reason to suppose that an investor in an industrial undertaking will seriously suffer by waiting until the undertaking has shown some signs of being industrially productive, and when he is invited to invest on the strength of an individual's "assurance" of the quantity of orders that can be obtained, and exaggerated, but far from positive, statements of the profits to be made, it would be but reasonable to enquire whether previous assurances and statements of necessarily prospective results have hitherto been verified.

In the development of such an enterprise confidence is a great aid to successful completion. It would be a pity to risk disturbing such prevailing confidence by the admission of holders of lesser faith. Investors who strike the balance should not grudge the present holders the reward of their confidence when it comes. It is appropriate that those whose enterprise has embarked upon the establishment of a series of companies and a series of factories on assurance should reap the reward of that enterprise.

ELECTRICAL EXHIBITION AT TAUNTON.

THE West of England and South Wales Electrical Engineering Exhibition was opened at Taunton on Saturday last by Field-Marshal Sir Lintorn Simmons, G.C.B., G.C.M.G., R.E., late governor of Malta. Prior to the opening ceremony, Sir Lintorn was entertained to luncheon at Clarke's Hotel, at which were present a large number of influential residents, including the mayors and other officials of many of the neighbouring towns and districts. Sir Lintorn, in replying to the toast of his health, after mentioning that he was an M.I.E.E., gave some interesting details of the most recent applications of electricity in connection with naval operations. Mr. H. G. Massingham gave a few details of the history of electric lighting in Taunton, which was inaugurated by him in 1885. At that time he put up at his own cost an experimental installation to afford the public an opportunity of judging of the merits of the Thomson-Houston system of arc lighting. The general approval was so marked, that the local authority resolved to substitute the new illuminant for gas in the central district, and the number of customers, which, on May 1st, 1886, was 10 only, using only 22 arc lamps, increased by April, 1887, to 23, using 62 lamps. The success of the light being now established, a local company was formed, the undertaking having outgrown Mr. Massingham's personal resources, and it has continued to show a steady and satisfactory development, there being now 82 arc lamps of 1,200 C.P. running, and several hundred incandescent lamps varying from 10 to 64 C.P. The increased demand for the light necessitated the removal of the company's works from the old and inconvenient depôt, and early in 1890 the present commodious premises were entered upon, and new plant laid down. This comprises two compound high pressure engines (each developing 80 brake H.P.), driving four Thomson-Houston 80 light arc machines, as well as an Elwell-Parker shunt wound machine for charging accumulators, and two Willans engines driving two Thomson-Houston 70 kilowatt alternators.

The exhibition is held on the premises of the Electric Light Company, a large enclosed yard having been covered with temporary shedding, so as to afford, with the permanent buildings, sufficient area for a satisfactory collection of exhibits, of which the machinery and apparatus of the central station itself form the most prominent feature. Mr. F. M. Newton, of the Newton Electrical Engineering Works, Taunton, has a good display of machinery and fittings, including a Taunton dynamo charging accumulators, electric

motors driving sewing machines, lathe and fan; and a variety of lamps and holders. He also shows a switchboard of novel construction, the object of which is to render the connections at the back more readily accessible than in the case of the usual fixed board. This is accomplished by hanging the switchboard on a horizontal post, after the manner of a gate. Another new invention shown here is Elton's electric incubator, intended for the hatching of eggs only, it being explained that the chicks are then transferred to a supplementary apparatus called the electric mother. (To the advocates of new units we may add that this is not a "Hen.") Gas engines are well represented, the Otto, the Stockport, the Midland, and the Express being all shown at work. Mr. E. J. Rigby, of Exeter, has a good display of fittings, in conjunction with Messrs. Rashleigh Phipps and Dawson, and a combined exhibit of fittings is made by the Exeter and Bath Electric Lighting Companies and the Keys Electric Company. Among the other exhibitors are the Automatic Standard Screw Com-Company, Messrs. King, Mendham & Co., Messrs. Davis and Son, Bath, the Blackman Ventilating Company, Messrs. J. J. Armfield and Sons (turbines), Messrs. Gilbert Gilkes and Co. (turbines), Messrs. Richard Freres, Messrs. Appleton, Burbey and Williamson, and Messrs. Laurence, Scott & Co. The Edison phonograph is on exhibition for a week, and on the river Mr. Kerbey Bowen, of Ray Mead, has an electric launch for hire. An endeavour was made to have an electric omnibus plying between the station and the exhibition, but this could not be accomplished. As good as anything inside the exhibition is the electric lighting of the town of Taunton, and the artistic display in some of the shops, such as that of Mr. Arthur Steevens, the local agent for Messrs. Liberty and Co.

ELECTRIC LIGHTING IN ST. SAVIOUR'S, SOUTHWARK.

In October, 1890, the Board of Works for St. Saviour's district, Southwark (which includes the parish of, and the church, Blackfriars), gave its consent to the Brush Electrical Engineering Company's request to be allowed to lay its mains in the district, a similar consent being also accorded to the London Electric Supply Corporation, Limited. The Brush Company further intimated to the Board of Works that they were about to enter into a contract to lay mains in the City, and asked the Board to allow them to lay mains running from their Southwark works over Blackfriars and Southwark bridges, to which the Board again consented. Recently an intimation was received from the Brush Company that they desired to make over their concessions to a new company to be formed under the title of the City of London Electric Lighting Company, and the Board was asked to allow a transfer of the Brush Company's rights to the new company. The Paving and General Purposes Committee was appointed to consider and report upon the application, which report, a few days ago laid before the Board, stated: "That the committee have considered an application from the Brush Electrical Engineering Company, Limited, for the consent of the board to the transfer, pursuant to section 61, of the Southwark Electric Lighting Order, 1891, of that undertaking to a Company to be formed under the title of 'The City of London Electric Lighting Company;' also for the consent of the Board to the transfer to the same Company of the Wayleave agreement between the board and the Brush Company, dated 7th November, 1890, and the memorandum thereto; also stating that the committee have considered a communication from Mr. Haggis, deputy chairman of the London County Council upon the subject, and recommending that the consent of the board be given to the proposed transfers, provided the City of London Electric Lighting Company will state in writing that their reading of the principal Act (the Electric Lighting Act, 1882) is to the effect that they are bound to keep separate accounts for the Southwark district, and will give an undertaking to do so." It was stated at the Board, however, that a letter had been received from Mr. Morse, pointing out that section 8 of the Act, under which the Brush Company would work in Southwark, expressly stated that separate accounts were to be kept, and the report of the committee was referred back. We are in a position to state that the Paving and General Purposes Committee will bring up a report to the effect that having again considered the application of the Brush Company for a transfer of their powers to the new company before mentioned, and having regard to the terms of section 8 of the order, the committee are of opinion that any special undertaking as to the keeping of separate accounts on the part of the new Company may be dispensed with, and that the transfer of the ordinary powers and the wayleave be granted.

PARLIAMENTARY NOTES.

In the House of Commons on Monday, July 27th,

Mr. D. SULLIVAN asked the Secretary to the Treasury whether he could hold out any hope that the engineering branch of the telegraph service would be placed on the same footing as regards classification; and, if not, would he state the reason for withholding the concession.

Sir H. MAXWELL: The hon. member has not stated in his question the branch of the postal or telegraph service with which he thinks the engineering branch of the telegraph service should be put on a level, and I am therefore quite unable to say whether any or what concession will be granted or withheld.

On Thursday, July 30th, Mr. RAIKES, in answering Mr. Webb regarding the telegraph engineers, said: The engineering branch performs work of a special character, and there does not appear to be any reason for making its classification uniform with that of another branch. But proposals affecting the pay of certain classes of engineering officers have been submitted to the Treasury, and are now receiving their Lordships' careful consideration.

LIGHTHOUSE COMMUNICATIONS.

On 27th ult. Mr. WEBB asked the President of the Board of Trade whether it was a fact that within the past few days one of the light-keepers on Tuscar lost a hand through an accidental explosion of gun-cotton, and would have remained some 16 hours without surgical attention but for having been taken off by the *Cephalonia*; and whether, for use in cases of accident or shipwreck, her Majesty's Government would consider the propriety of establishing telegraphic or telephonic communication with the more important of the lighthouses situated on rocks and islands round the United Kingdom.

Sir M. HICKS-BEACH said: I have no reason to doubt the accuracy of the account of the accident referred to as given by the hon. member, but the injured man was, as a matter of fact, promptly taken off for surgical treatment, and I do not think this particular case could be quoted in support of the necessity of establishing the communication to which the hon. member refers, however desirable it may be on other grounds.

LEGAL.

Andrews and Preece, Limited, v. Scott.—Mr. Waddy, Q.C., M.P., and Mr. Chitty appeared for the plaintiffs in this slander case, and Mr. E. T. Atkinson, Q.C., and Mr. Waugh were for the defendant.

Mr. WADDY, in opening the case, stated that the plaintiffs were a firm of electricians, carrying on business at Bradford, and the defendant, Mr. Adam Francis Scott, was, or had been, the manager of the Bradford business of Messrs. Woodhouse & Rawson, the well-known electrical engineers. In February last a Mr. Arthur French, managing director of the Estates Realisation Company, Bradford, expressed a desire to have the company's place of business lighted with electric light. Tenders for that work were submitted by Mr. Scott on behalf of his firm and by Mr. Douglas, electrical engineer, for Messrs. Andrews & Preece. Mr. French saw Mr. Scott on the afternoon of February 19th, and told him that he (Mr. French) had decided to accept the tender of the plaintiffs, whereupon the defendant said, "It is no use your giving the work to Andrews and Preece, because they come to us to buy all their stuff, and have tried to buy any sort of rubbish that we cannot supply. They will make a mess of the job." It was perfectly clear, said Mr. Waddy, that this was defamatory in a high degree. The defendant did not attempt to justify it and not a word of it was true. Similar observations were made to Mr. G. H. Isitt, of Bradford. The present action was not brought, however, with a view to inflicting any personal injury upon a rival in trade. The plaintiffs had no desire to punish the defendant, but they could not permit him to continue making damaging accusations against them, and if he would promise to abstain from making such statements in the future the plaintiffs would be satisfied.

Several persons, including Mr. French, Mr. Douglas, and Mr. G. H. Isitt, gave evidence in support of the plaintiffs' case.

Adam Francis Scott, the defendant, then entered the witness box, and denied that he had ever made the statements attributed to him. When Mr. Isitt told him that his firm had obtained a tender considerably lower than that of Messrs. Woodhouse and Rawson all he (the witness) said was that he could not do the work at a lower sum than that stated in the tender, and that he hoped what anyone else did would be satisfactory. The name of Messrs. Andrews & Preece was never mentioned. He never said that the plaintiffs bought old stock from the Schmidt-Douglas Company. Cross-examined by Mr. Waddy: Some of the statements made by Mr. Isitt were pure inventions. He never used the word "rubbish."

This concluded the case for the defence, and Mr. WADDY, in addressing the jury, said that after the statements made by the defendant in the witness box he would withdraw the offer held out in his opening remarks, and ask the jury to award the plaintiffs such damages as they might consider them entitled to.

His LORDSHIP said the jury could hardly doubt that the words complained of, if used, were defamatory, and it therefore became a question of the credibility of the witnesses and of the amount of damages.

The jury found a verdict for the plaintiff for £75.

The Boy Messengers Company and the Post Office.—In the Court of Queen's Bench last week, the case of the Attorney-General *v.* the Boy Messengers and Electric Call Company came before Justices Denman and Collins, sitting as a Divisional Court.

Mr. CASSERLEY, on behalf of the Crown, said that on April 14th last an injunction was granted against the Boy Messengers Company as then constituted, but soon after that decree the company was re-constituted for the purpose of extending their operations for telegraphic purposes. It became necessary for the purposes of protecting the revenue that the injunction should be also extended. The

new company, which was called the Boy Messengers and Electric Call Company, had agreed to submit to the injunction in the terms of the prayer of the new information, and minutes to that effect had been signed on behalf of the company by Mr. Ernest Pollock.

Mr. POLLOCK, for the company, assented to these terms.

The court granted the injunction in the terms asked for.

Crompton and Company v. Phillips and Phillips v. Crompton and Company.—In the Appeal Court before Lord Justice Lindley, Lord Justice Bowen and Lord Justice Kay, judgment was given on Wednesday in this matter. It was a motion for a new trial of an action tried by Mr. Justice Day and a special jury in the Queen's Bench Division to recover from Mr. Phillips damages for defective wire supplied to Messrs. Crompton & Co., the defendants, to be used by them in the lighting of Chelmsford, and in which a verdict was given for the plaintiffs. Against this Mr. Phillips appealed, the appellant being represented by Mr. Finlay, Q.C., with whom was Mr. R. W. Wallace, and the respondents by Mr. Moulton, Q.C., with whom was Mr. J. C. Graham.

LORD JUSTICE LINDLEY, in delivering judgment, said this was a motion for a new trial of a cause tried by Mr. Justice Day with a jury. The verdict was for the plaintiffs, but the jury said, "We feel that Messrs. Crompton"—that was the plaintiffs—"had been guilty of contributory negligence in not examining the goods which were an exceptionally bad article." Now, it had been said by Mr. Finlay and Mr. Wallace that exceptionally bad meant exceptionally bad for the purpose to which it was applied; that it ought never to have been applied to out-door lines for then it was exceptionally bad. But the defendants said they had never meant it for that purpose; but he (Lord Justice Lindley) thought it was susceptible of this meaning, that it was an insulated wire, and that it was an exceptionally bad article of that kind—as an insulated wire. And what the jury had meant by the expression "contributory negligence" was—as he understood the judge asked the jury to consider the question first and leave the damages to after consideration—the meaning was an intimation by the jury that when they came to consider the damages they were not going to give the plaintiffs all that it had cost them to put up and take down the wire, because they ought to have examined it. It appeared that the question of damages never went to the jury, but was referred, and he supposed the gentleman who had to deal with the question of damages would take the same view. It appeared to him (Lord Justice Lindley) utterly unreasonable and wrong to give the plaintiffs all the cost of putting up and taking down the wires, because they could have discovered with the slightest trouble that it was defective. It was impossible to say that the verdict was against the evidence, or that there had been such a miscarriage of justice as to require a new trial. He attributed the unfortunate misunderstanding which had occurred entirely to the ambiguity of the word used. If the defendants had sold this as covered wire there would have been no difficulty.

LORD JUSTICE BOWEN and LORD JUSTICE KAY also concurred.

NOTES.

The Westinghouse Company's Reorganisation.—We learn that this matter has become an accomplished fact, and that the reorganised company is now considered as one of the most formidable in the field, and as being far more likely to-day to get to business and do it profitably than was the case in the time of its inflation and extravagance.

A Leakage Detector.—An apparatus for detecting the leakage of electricity upon house or other mains has been brought out by Messrs. Sandy and Easter, of Choumert Road, Peckham. The makers state that with the apparatus they have succeeded in detecting the leakages in an experimental installation, having an insulation resistance of five megohms with an electromotive force of 100 volts. The arrangement consists of a small board on which are three keys. The connections are so made that by pressing the centre key the potential between two terminals may be read off upon a voltmeter connected to them, and by pressing the centre and either the right or left hand key down together the potential to earth on the positive or negative mains respectively may be read off on the voltmeter, if it is sufficient to actuate the instrument. Below the voltmeter terminals are two pins, for the purpose of holding a piece of pole-testing paper, so that if there be a leakage which is too small to be detected upon the voltmeter it will still be noticeable by the effect produced upon the paper, thus showing that the insulation resistance is low. The makers supply papers for detecting leakage upon circuits of 100 volts potential, where the insulation resistance is from 1 to 3 megohms, and these papers only change colour when the insulation resistance is below the standard for which they are supplied. The arrangement appears to be a handy one.

An Electrical School for Manchester.—The Council of the Manchester Technical School have taken over some premises for the purpose of establishing a practical training school of electrical engineering. It is hoped that the school will be ready in time for the coming winter session.

Electric Lighting at Madrid.—There has been a change in the management of the English company which supplies electricity in Madrid. The mistake made by the company consists in keeping up the price at an extravagant charge, which tends to limit the amount of business. The company would make a reasonable profit by electric lighting, even if they charged less than for gas and petroleum lighting. The price of petroleum in Madrid is five times as great as in London.

An Application of Electricity to the Separation of Ores and Metals.—This new application is due to the ingenuity of the Italian electrician, E. Ferraris, and may be thus briefly noticed in its salient features: There are four-and-twenty electro-magnets, which are arranged radially on a hub, their outer poles being all joined by a circular metal rim like a broad tyre, the whole resembling a wheel. The magnet-coils are all joined in one continuous circuit, like that of a Gramme armature, with connections to a commutator. When a current is led into the latter, one-half of the rim becomes of north and the other half of south polarity, the commutator keeping the position of the poles in space uncharged during rotation. The surface of the magnetised rim is notched or furnished with projections, and ore fed upon its surface from above, falls from the wheel into heaps in different positions according to its magnetic susceptibility, the most magnetisable being carried right under the wheel. By the peculiar construction of the commutator, which resembles in principle that of the Immisch motor, two neutral zones are left between the two magnetised segments of the ring.

Royal Naval Exhibition.—Among the numerous exhibits of private firms at the Naval Exhibition now open at Chelsea, we notice that belonging to Messrs. Woodhouse and Rawson United, Limited, of 88, Queen Victoria Street, London. At the company's launch works, near Kew, there are at present several launches, varying in size up to 50 feet in length, in course of construction. Models are shown of some recently delivered, amongst which we notice one which has been built for the Mexican Government. To show how easily electricity lends itself to launch propulsion, the manager of the company's boat building department has constructed a working model, in which the screw is attached directly to the axle of the armature of the motor. In another part of the stall we notice a small model of Bolton's electric winch. The high speed at which an electro-motor economically rotates is in this machine reduced by means of a screw gearing into a toothed wheel. The company have great confidence in this special application of the electric current, and are sure that it only requires to be more generally known to be extensively adopted. The "Sun lamp" is on exhibition. It has now been perfected, and is about to be reintroduced to the English market. Its perfect steadiness and freedom from mechanism will commend it to all. The company also exhibit a number of hand lanterns made of thick glass, in which the incandescent lamp is entirely enclosed, so that there may be no danger from breakage, as the lamp is carried from one part of the ship to another. There are also a selection of lampholders and lanterns for affixing to partitions and attaching to ceilings in fitting up installations on board ship. The advantages of the single stroke Jensen bell, particularly as adapted for signalling purposes on board ship, are shown to all who may be willing to pause for a moment, while it is almost needless to say that the quick break switches for which the company are so well known are also shown. We notice that both in the sample of the 1,000 ampère and the three-way 500 ampère types that sockets are provided for "sweating in" the cables. A six-way distributing switchboard and a number of Cunynghame, Woodhouse and Rawson's magnetic cut-outs are also on view. These still appear to be in great demand, and although one of the first safety devices introduced, they appear to be still great favourites.

Bath Lighting.—At a meeting of the Surveying Committee at Bath on the 27th ult. the usual bills were presented for payment, and amongst them was a quarter's account due to the Bath Electric Light Company, amounting to £523 19s. 4d. It was asked whether any allowance had been made for the lights going out, but the police report stated that none had been out since 29th June. The account was ordered to be paid.

Electrical Boring Machine.—We hear that in connection with the Manchester sewage scheme, a great deal of blasting has been found necessary to effectually cope with the rock. A new kind of boring machine has been introduced, which is said to mark a great advance upon other machines. It is to be worked by electricity, with a dynamo of 12 horse-power, and is calculated to bore into the sandstone rock beneath Deansgate at the rate of ¼″ per minute, or 20 feet a day.

The Gospel by Telephone.—Some time ago experiments were tried at a church in Birmingham to connect the pulpit with the telephone system, so that invalids and others could hear a preacher without attending the service. These arrangements have now been completed, and oral sermons are now being supplied at private residences on an extensive scale. A dozen yards or so of loose, flexible cord, is attached to the ordinary receiver, and a special U-shaped instrument supplied to fix on the head with an ear-box for each ear. Subscribers in Manchester, Nottingham, London, Coventry, Stafford, Wolverhampton and Worcester have also taken the opportunity of hearing a spoken sermon at a trifling cost.

Frankfort International Electro-Technical Congress.—The following list gives the programme to be carried out at this Congress, which is to be held at Frankfort-on-Maine, from the 7th to the 12th September. The papers which are down for reading were notified in the REVIEW for July 17th :—

Monday, September 7th.

Evening, 8 o'clock ...	Welcome to the participants in the Saloon of the Great Restaurant, in the place of Exhibition.

Tuesday, September 8th.

Forenoon, 10 o'clock	First principal meeting in the Theatre, in the place of Exhibition.
Afternoon, 4 o'clock	Formation of the Sections.
Evening, 7 o'clock ...	Festival performance in the Theatre of the Exhibition.
Evening, 9 o'clock ...	Banquet in the Saloon of the Great Restaurant, in the place of Exhibition.

Wednesday, September 9th.

Forenoon, 10 o'clock	Sittings of the Sections.
Noon...	United Inspection of distinguished subjects of the Exhibition.
Afternoon, 5 o'clock	Festival Dinner in the Great Saloon of the Garden of Palms.
Evening, 8 o'clock ...	A double Promenade Concert in the Garden of Palms.

Thursday, September 10th.

Forenoon, 10 o'clock	Second principal meeting in the Theatre of the Exhibition.
Afternoon, 4 o'clock	Sittings of Sections and common inspections.
Evening, 7 o'clock ...	Social entertainment in the Marine Exhibition; Grand Vocal Concert; Illumination of the Banks of the Maine.

Friday, September 11th.

Forenoon, 10 o'clock	Meetings of Sections.
Afternoon	Inspection of the Exhibition, particularly of the Special Exhibition of Tools, Materials and Machinery relating to superior technical subjects.
Evening, 6.30 o'clock	Festival performance at the Opera House.

Saturday, September 12th.

Forenoon, 10 o'clock	The last principal meeting in the Theatre of the Exhibition.
Evening, 7 o'clock ...	Festival Ball in the Saloons of the Zoological Garden.

Sunday, September 13th.

Forenoon & Afternoon	Excursions by special trains to Wiesbaden.
Evening	Great Garden Festival in the Cour Park, and brilliant Fireworks, given by the Municipal Directors of the Cour establishment.

Frequency of Thunderstorms.—A German periodical gives statistics concerning the frequency of thunderstorms in various regions of the world. Java has thunderstorms on the average 97 days in the year; Sumatra, 86; Hindostan, 56; Borneo, 54; the Gold Coast, 52; Rio de Janeiro, 51; Italy, 38; West Indies, 36; South Guinea, 32; Buenos Ayres, Canada, and Austria, 23; Baden, Wurtemberg, and Hungary, 22; Silesia, Bavaria, and Belgium, 21; Holland, 18; Saxony and Brandenburg, 17; France, Austria, and South Russia, 16; Spain and Portugal, 15; Sweden and Finland, 8; England and the high Swiss mountains, 7; Norway, 4; Cairo, 3. In East Turkestan, as well as in the extreme north, there are almost no thunderstorms. The northern limits of the thunderstorms are Cape Ogle, northern part of North America, Iceland, Novaja, Semelja, and the coast of the Siberian ice sea.

The Speed of Electricity.—The operations which are in progress at Montreal, under the auspices of the Canadian Government, for the purpose of determining the exact longitude of that city by direct comparisons with Greenwich time, have led to some interesting results. It was necessary to determine the time taken for an electric signal to traverse the Atlantic Ocean. The apparatus was so arranged as to obtain a circuit from Montreal to Great Britain and back again, and a chronograph was provided in order to determine the time taken by the signal in thus traversing the Atlantic Ocean twice. The mean of 100 observations has given 1·05″ for this distance, which is about 13,000 kilometres. The experiments are still being pursued with a view to obtaining accurate figures, and these will be checked by similar experiments, which will be carried on between Montreal and Vancouver over the telegraph lines of the Canadian Pacific Railway.

The Electric Propulsion of Ships.—In considering the future possibilities of science, Mr. Oberlin Smith, in a lecture recently delivered before the Franklin Institute, propounded the idea that the ships of the future will probably be driven by electricity, by means of a simple rotating armature fixed directly upon the shaft of the screw itself. The source of the electric current for driving the motors of these prospective three or four-day Atlantic liners, Mr. Smith considers would probably be storage batteries placed in the extreme bottom and along the whole length of the hold, where they will serve as excellent ballast, or else the current will be generated by some direct process from coal or other fuel, either burned or otherwise chemically disorganised during the passage. Mr. Oberlin Smith's dream of an ideal telephone to which we have drawn attention in our leading pages, seems to have disorganised his brain, or his knowledge of accumulators is but slight.

Lightning Dangers.—We have had during the last two weeks such a series of thunderstorms, attended by alarmingly frequent fatalities and serious injuries from lightning strokes, that it is high time the public should be warned against the extreme danger of sheltering under trees, especially if these are solitary ones and far removed from others. The danger of standing under a tree, however, is considerably minimised by keeping as far away from the trunk as possible, and remaining in such a position as to ensure a lengthy air space between the branches and one's head. It is almost certain that these fatalities would rarely be heard of if people would take care to stand at a distance of several yards from the trunk or spreading branches of a tree; but, as a rule, the belated wayfarer in search of shelter almost hugs the trunk in his anxiety to keep dry. It is lucky for the inhabitants of this country that the frequency of thunderstorms during the year is but slight compared with other parts of the world; indeed, England is, with but few exceptions, the most favoured spot on the globe. Nevertheless, the experiences of the last fortnight have been enough to make nervous individuals away from towns feel very anxious when caught in the midst of a thunderstorm accompanied by drenching rain; and Dr. Oliver Lodge would be doing no small service if he would formulate a few precautionary measures for the public to observe at such times.

Lighting of the British Museum.—The electric lighting of the British Museum will be completed early this month, and the literary work carried on there can be continued all night long if necessary.

The Storage Battery in America.—Judge Coxe, in the United States, has again sustained a former judgment of his in favour of Mr. C. F. Brush on the employment of an active material mechanically applied to a storage battery plate. It is to be hoped, says the New York *Electrical Engineer*, that this decision may finally place the storage battery in such a position that its commercial exploitation will no longer be retarded, as it certainly has been in the past, by the fear of legal complication arising to the user. Indeed, indications are not wanting to show that this will be the case in the immediate future.

Reduced Cable Rates.—A Melbourne despatch states that the result of the first month's business under the reduced cable rates has been highly satisfactory from a departmental point of view. The gross receipts for cable messages during May amounted £4,265, the average monthly receipts from January to April being £5,090. The number of words transmitted during May was 20,612, the average number for the previous months of the year being only 11,405. It will thus be seen that the decrease in receipts was only 16·18 per cent. on the average for the four months, while the increase in words was 80·77 per cent.

Walter T. Glover and Company.—Owing to the increase in their London business, Messrs. Walter T. Glover and Co. have removed from 10, Hatton Garden, to larger and more commodious offices at Albany Buildings, 39, Victoria Street, Westminster, where they hope for the continued support of their electrical friends. Considerable alterations and extensions having been made in their works and machinery at Manchester, they are now prepared to give prompt delivery from stock of wires and cables for electrical purposes. Mr. Henry Edmunds begs to call the attention of his London friends to his change of address as above.

Shoreditch Electric Lighting.—Three private companies have given the Shoreditch Vestry notice that they intend applying in the next Session of Parliament for provisional orders giving them the power to supply electric light and power in this parish. The Parliamentary Committee, therefore, recommended that "The Vestry apply in the next Session of Parliament for a provisional order empowering them to supply electric light and power in this parish, and to transfer and let out the work hereafter, if thought desirable, and that the Vestry Clerk be instructed to take the necessary steps to obtain the order." It was decided to call a meeting at 7 o'clock on the first Tuesday in September for this purpose.

London Hospitals and the Telephone.—A young medical friend has called our attention to a matter in which the employment of the telephone would be of the greatest service. It is not an uncommon occurrence for persons who meet with accidents in the streets, and who are sent in cabs to the nearest hospital, to find that there is no room; the cabman must then go on his way to another, often with the same result. It will readily be seen, then, that the connection of the London hospitals by telephone would serve a most useful purpose, for in a few seconds it might be readily ascertained from the first place to which a patient is carried, where, failing his instant admission, a vacant bed was to be found. In urgent cases this would be especially valuable, and, in any case, the time which elapses between the occurrence of an accident and its treatment might be materially reduced, and much unnecessary suffering avoided. To business men, the telephone as at present fitted up and managed has been by no means an unmixed blessing, but probably a circuit which connected the London hospitals might be kept free from disturbing influences, and good talking thereby ensured; so to the authorities of these institutions, and to the National Telephone Company, we commend the idea.

Frank Suter and Company.—Messrs. Frank Suter and Co. have removed from 276, Strand, to 66, Berners Street, W.

Electric Lighting of Ships.—Messrs. J. H. Holmes and Co., of Newcastle, have a good number of ship lighting orders on hand. During the past month installations on the following steamers have been completed:—*Lanfranc*, *Sedgemore*, *Indianopolis* and *Angola*. In addition to these, the installations on the following vessels are approaching completion:—*Santos*, *Pelotas*, *Ruthenia* and *Minna*.

Electric Lighting in Burma.—After many experiments with the different kinds of mineral oil lamps, we learn from *Indian Engineering* that several millowners have recently adopted the electric light. The premises of Messrs. Bullock Bros. in Kemmendine, Messrs. Mohr Bros. in Poozoundong, and the yards of the Burma Oil Company, are now lighted in this way.

Sham Electro-Medical Appliances.—At the North London Police Court, a deaf person applied to Mr. Slade for advice with respect to a "professor" who guaranteed to cure deafness for the sum of two guineas. He undertook to do this by means of what he called an electric appliance; but he could find no electricity in it, and up to the present there was no improvement at all in his hearing, although he had been using the appliance for over three weeks. After having further particulars, Mr. Slade stated that it was a case for the County Court, and the applicant left the court looking very dubious.

The American Edison Lamp Case.—It seems likely that the Edison Company and some 70 subsidiary offshoots will adopt a lenient mode of dealing with infringers of Edison's lamp patent; indeed, Judge Wallace plainly intimates, as far as he is concerned, that not a little consideration is due to the vanquished. An expression of opinion on the part of the court is very striking. As to the temptation to innocent, or even justifiable infringement, it said: "The greatest cloud that hung over the patent was in its claims—in the language of the patent itself. *He did not much blame any infringer for assuming that he could go on and make any sort of an incandescent lamp without fear of that patent.*"

Alternate Current Distribution in the States.—A very general impression has prevailed in American electrical circles that the matter of controlling patents in the alternate current system of distribution was practically settled by the defeat of the Westinghouse Company's Gaulard and Gibbs patent in 1888. Now it appears that the Westinghouse people have another trump card in the 1883 patent of Rankin Kennedy, based on his discovery of the self-regulating properties of converters when arranged in multiple arc. Although Kennedy did not patent his invention in the States till 1889, still it was in time to make it valid under the provisions of the statute. It was fully described in the ELECTRICAL REVIEW for June 9th and 16th, 1883. The issue hanging upon this is thought to be nearly as important as that decided in the lamp case.

A New American Electrical Paper.—The first number of *Electricity*, a well-printed and attractive-looking paper, hailing from Chicago, has reached us. It is to be published weekly, and aims at being popular, practical, technical and theoretical at the same time. We fail to find that it differs in any material respect from several other American contemporaries, or that it breaks fresh ground. That its proprietors are business-like is shown by the announcement, written before the first number had even been scanned by its would-be readers, that, "As *Electricity* reaches all classes interested in electrical work, its value as an advertising medium can be readily appreciated." Truly America affords a happy hunting ground for the electrical journalist, and *Electricity* is to be the most readable and handsome journal published, if time, money, and persistent effort will effect the result.

Electric Light Standards in Brussels.—The commission appointed in Brussels to examine the designs for electric light masts has given its decision. The first prize of 1,000 fcs. has been awarded to M. Acker the author of the "prestó" project, and the second of 500 fcs. to MM. Spongers and Smets for the design "Fiat Lux."

Proposed Electric Lighting at Worcester.—At a meeting of the Watch Committee last week, a report was adopted recommending the appointment of Mr. Swete to canvass the inhabitants, and ascertain how many would be likely to take electric light if provided. They also submitted a form of circular to be sent out.

The Telephone in Newcastle-upon-Tyne.—We observe that the National Telephone Company is making rapid strides in the development of their system by the laying along the side toward Dean Street, of six three-inch pipes (capable of containing about 500 wires) which we understand is essential to meet the increasing demand for telephone communication.

Telephoning Dangerous to Health.—The French Postal authorities are said to have discovered that infectious diseases can be communicated by the membrane of telephones. It is stated that the danger of infection may be averted or at least minimised by frequent and careful cleaning of the membrane with carbolic acid.

Government and Telephone Companies.—The Postmaster General has intimated to the Wolverhampton Chamber of Commerce that the Government do not intend to take over the business of the telephone companies immediately. They are, however, prepared to establish telephonic exchanges where required. The whole matter of such communication is still being considered by the department.

Transforming Alternating into Direct Currents.—Some discussion, say *Industries*, has lately risen as to transforming by means of an alternating current motor driving a direct current motor. There is, however, no novelty about this. It was fully described in a patent in 1887, which is now void, as the inventor did not think it worth £10 a year. It is probable that the system has been described even before 1887. We believe that our contemporary is right, for it seems to us a very old idea.

York Lighting.—At a meeting of the Streets and Building Committee of the York City Council on 28th ultimo, the report from Mr. Crompton was received. This gentleman had been appointed as electrical engineer to advise the corporation regarding the proposal to introduce electric light in the city. The report was discussed fully, after which instructions were given to the Electric Lighting sub-committee to visit Bradford and Newcastle for the purpose of gaining information as to the relative advantages of the high and low tension systems.

Electrical Engineer for Hull.—At a meeting of the Electric Lighting Committee of the Hull Corporation on 27th ult., the council appointed Mr. F. Harman Lewis, Associate of the Society of Electrical Engineers, as their engineer on the recommendation of the committee, at a salary of £250 per annum. Mr. Lewis is at present with the St. James' and Pall Mall Electric Light Company. There was some discussion regarding the site on which to erect the proposed central station, but this was of a private nature.

The Work of Tesla, Kennedy and Gordon.—Touching the general interest aroused in electrical circles by the results of Mr. Tesla's experiments, it may not be out of place to call attention to the lamp invented by Mr. J. E. Gordon, and described in the REVIEW for December 1st, 1880. Mr. Kennedy briefly alludes to it in his article this week, and we feel sure that but few persons have anything but a faint recollection of Mr. Gordon's work in the direction of producing a workable lamp without a filament.

Italian Electric Launch.—The Electrical Industrial Company of Milan is now introducing electric launches. The first is to be placed on the Lake of Como, and is illustrated in the last issue of *L'Elettricita*. It is provided with an Immisch motor and carries 40 cells.

County Hall Lighting by Electricity.—The County Hall Committee of the East Sussex County Council have instructed the architect of the new county hall to prepare plans, specifications, and estimates for lighting the County Hall and offices by electricity.

Electric Ballot Vote Counter.—An electric ballot vote counter, scrutineer and detector, the invention of Mr. Alfred W. Hosking, of West Smithfield, is at present being demonstrated at Morley Hall, Regent Street. The object of the apparatus is to secure infallibility and inviolable secrecy in the counting of votes, combined with a saving of expense. A description of the means whereby these ends are secured we are obliged to hold over till our next publication.

Effect of Electric Light on Fish.—A correspondent of *Land and Water*, in a letter under this heading, states that fishing all along by Totland Bay, I.O.W., was very poor, and that since the setting up of the search light for the forts it had become worse. He also heard that there used to be a very good place for fish near the lighthouse at St. Catherine's Point, but that the electric light had driven them all away, and now it was quite useless putting out nets in a spot where a few years since a decent haul was looked on as a certainty. He solicits opinions on this matter from those who are more versed in sea-fish and their ways than he is himself.

Chicago Exhibition.—A very important question which has arisen in connection with the Chicago Exhibition relates to the employment of foreigners there. Under the contract labour laws of the United States it is forbidden to bring into the country any alien under contract to perform any duties whatever, and it has naturally been suggested that this would prevent foreign exhibitors from taking over their own clerks, attendants, or workmen. In order to settle this point, the Secretary of State requested an official opinion from the American Attorney-General upon the subject. After fully discussing the legislation upon the subject, the Attorney-General has rendered an opinion that skilled *employés* of foreign exhibitors at the Chicago Exposition, who come, in good faith, for the purpose of setting up and operating the machinery of such exhibitors, are outside of, and not subject to, the contract labour laws of the United States. The same opinion is expressed with reference to clerks, stall-keepers, and other persons coming to the United States for the sole purpose of aiding foreign exhibitors.

The Electric Light in 1988!—A successor to Bellamy's well-known book, "Looking Backward," has recently appeared. It is called "Cæsar's Column," and is written by Edmund Boisgilbert. The book differs from that of Bellamy's in so far that while "Looking Backward" pictures *what ought to* be, "Cæsar's Column" describes *what may* be. It is not within our province here to refer to the full scope of the book, but that little portion referring to electricity we reproduce herewith, thinking that it may be of interest to our readers to know what they may expect to see—if they only live long enough—in the year 1988:—"As we approached the great city in our great air-ship, coming from the east we could see, a hundred miles before we reached the continent, the radiance of its millions of magnetic lights reflected on the sky like the flare of a great conflagration. These lights are not fed, as in the old time, from electric dynamos, but the magnetism of the planet itself is harnessed for the use of man. That marvellous 'earth force' which the Indians called the 'dance of the spirits,' is now used to illuminate this great metropolis (New York) with a clear soft white light like that of the full moon, but many times brighter, and the force is so cunningly conserved that it is returned to the earth without any loss of magnetic power to the planet. . . . . Night and day are all one, for the magnetic light increases automatically as the daylight wanes."

South American Cables.—A Cayenne telegram states the Société Française-des Télégraphes Sous-Marins has just completed the laying of its telegraph cable between Paramaribo, in Dutch Guiana, and Cayenne.

The Editor Abroad.—The *Practical Engineer* is again showing its readers the practical nature of the information given in its columns on the subject of electricity. In last week's issue it is stated that the current for a large electric locomotive, built by the Thomson-Houston Company, is supplied by a 500 volt dynamo, having a capacity of 30,000 *volts*. This is small compared with the capacity of our contemporary for distorting electrical news.

The Electrical Engineer to St. Pancras.—The selection of electrical engineer and general manager to the vestry of St. Pancras was settled on Wednesday last week. There were 47 applicants, but these were reduced to three, whose names were sent up to the vestry. These were John Thomas Barron, of Leeds; Gerald William Partridge, Russell Square, and Alfred Slatter, Barnes. Mr. Partridge, however, withdrew his candidature on Wednesday, so that there were only two candidates to choose from. The result of the ballot was declared, when it was found that Mr. Barron was elected by 52 votes to 21 cast for Mr. Slatter.

Electric Lighting of the Central Station, Manchester.—The Cheshire Lines Committee have recently decided to erect an installation for the complete lighting of their Central Station, Manchester, and have placed the order for the whole of the plant with Messrs. Mather and Platt, of the Salford Iron Works. The plant will consist of incandescent lamps for the refreshment rooms, ticket offices, and waiting rooms, and arc lights for the platforms. The plant is to be in duplicate throughout, and will consist of compound engines, "Edison-Hopkinson" dynamos for the incandescent lighting, and "Manchester" dynamos for the arc lighting.

Woodhouse and Rawson United.—Messrs. Woodhouse and Rawson have recently constructed at their foundry at Kidsgrove, Staffordshire, the machinery for new waterworks at Audley, consisting of pumps capable of delivering 20,000 gallons per hour into the high-service reservoir, through three miles of leading mains from a depth of 530 feet. These are worked by engines of the compound coupled type of 110 indicated H.P. when working at their normal speed of 75 revolutions, with a boiler pressure of 70 lbs. Steam is generated in two Cornish boilers, each 6 feet in diameter and 24 feet long, made of best Staffordshire plates, and tested by hydraulic pressure to 120 lbs. per square inch.

Death from Electricity.—A New York telegram states that on Monday last a bar-tender in a restaurant there accidentally touched a small electric motor, and fell dead without a cry. The motor is only of 1 horse-power, and the Brush Electric Light Company, which furnished the current, declare that the circuit was only of 500 volts. The doctors say that there was no heart disease, and that he was a strong and healthy man, 24 years old. There was no exterior trace of the electricity, but the usual *post-mortem* signs of death from that cause were present. This, however, is not the first death from a shock on a circuit of 500 volts E.M.F.

City and South London Electric Railway.—In view of the extension of the line from Stockwell to Clapham, for which the company already have Parliamentary powers, they are making arrangements for a considerable extension of the generating plant at the Stockwell station. They have placed the order with Messrs. Mather and Platt, of Manchester, for a fourth generating dynamo, similar to the three at present working the line. The dynamo is to be of Messrs. Mather and Platt's patent "Edison-Hopkinson" type for an out-put of about 400 horse-power. The company have also ordered a fourth engine from Messrs. John Fowler & Co., similar to the three existing engines, and have made arrangements for an increase of their rolling stock.

Canterbury Lighting.—At a meeting of the Canterbury Town Council on Tuesday, the Town Clerk read a letter from the Brush Electrical Engineering Company saying that they were prepared to undertake the formation of a local company to take over the provisional order which the corporation has obtained, and to refund the cost of the order (which they understood to be about £200) as soon as the necessary capital had been raised. The Mayor said at Dover they had advertised for tenders to take over the provisional order, but he did not know the result. The Mayor proposed that their Town Clerk write to the Town Clerk of Dover asking him to send particulars of what had been done and report at the next meeting, and this was agreed to by the members, and possibly Canterbury and Dover will act in concert.

Cambridge Lighting.—On several occasions when experts have been called in by town councils to advise on the best means of lighting their towns by electricity these experts have succeeded in getting their own special system adopted by the authorities, and we have never flinched from commenting freely on the subject when we felt compelled to do so. But in none of these cases have the electric lighting committees stultified themselves. This has been reserved for the council of Cambridge, who, after appointing Dr. Fleming as their electrical adviser or expert, summarily dismiss him because he reported adversely to the Electric Lighting Committee's pet scheme, at the same time stating at length his reasons for so doing, and recommending the committee not to decide the question without further advice. Apparently the council consider that a consulting engineer is not to be a man who will give a fair opinion according to his unbiassed and honest convictions, but one who shall be subservient to their will, and will clothe his report in language agreeably thereto, so that although the wording may be that of his employers yet the public shall believe it to be the truthful judgment of a professional man whose reputation and signature will impart to it a value of the utmost importance.

NEW COMPANIES REGISTERED.

Epstein Electric Accumulator Company, Limited.—Capital, £101,000 divided into 100,000 ordinary and 1,000 founders' shares of £1 each. Objects: To acquire the patents and patent rights of Mr. Ludwig Epstein relating to the invention of improvements in the manufacture and use of secondary or storage batteries; to manufacture secondary batteries under the said patents and patent rights, or according to the said invention; to carry on the business of an electric light company in all its branches; to construct, lay down, establish, fix and carry out all the necessary engines, cables, wires, lines, accumulators, lamps and electric plant for the generation, accumulation, distribution and supply of electricity; and to carry on the business of electricians, electrical contractors, electrical and mechanical engineers, manufacturers of electric apparatus, merchants, bankers, brokers, shippers, &c. Signatories: Sir J. D. Mackenzie, Bart., Worcester Park, Surrey; H. G. Rawson, 6, Pump Court, Temple; L. Epstein, 5, Cambridge Villas, East Twickenham; J. Maier, Ph.D., 23, Melrose Gardens, W.; G. T. Broadbridge, 55, Doddington Grove, Kennington Park, S.E.; F. Harland, 69, Lavender Sweep, Clapham Common, S.W.; J. Davies, 46, Derby Road, Croydon. The number of directors is not to be less than 3 nor more than 12, the first to be appointed by the subscribers, and until such appointment the subscribers themselves shall act. The remuneration will be fixed by the company in general meeting. Registered on the 31st ult. by A. L. Foley, 2, Marsemore Mansions, South Hampstead.

Electrical Assets Purchase Company, Limited.—Capital, £1,000 in £1 shares. Objects: to acquire and take over the whole of the assets and effects of the Liepmann Carbon Company, Limited, including its British and foreign patents for "Improvements in the manufacture of carbon for electric lighting," and to manufacture carbon for electric lighting purposes generally. Signatories (with one share each) E. Pope, 25, Redesdale Street, Chelsea; P. Storr, 7, The Triangle, North Kensington; W. R. Woolston, 4, Cromwell

Terrace, Worsley Terrace, Leytonstone, E.; W. W. Thompson, 40, Canton Street, Poplar, E.; H. W. Evans, 28, St. John's Road, Croydon; E. H. Hoskins, Hoddesden, Herts; W. W. Wotton, 22, Blue Anchor Lane, Bermondsey. The number of directors is not to be less than two nor more than five. Remuneration will be determined from time to time at the general meeting. Registered on the 28th ult., by Robinson and Stannard, 19, Eastcheap, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Metropolitan Electric Supply Company, Limited.—The annual return of this company made up to May 13th, 1891, was filed on May 22nd. The nominal capital is £500,000 divided into 49,900 ordinary and 100 founders' shares of £10 each. 45,932 ordinary, and the founders' shares are taken up, upon 43,900 of which £9 per share has been called, while the remainder were issued as fully paid. The calls paid amount to £392,500 9s., and unpaid to £2,599 11s. Office: Winchester House, E.C.

Williamson Electrical and Engineering Company, Limited.—At an extraordinary general meeting of the above named company, held at the office, 14, St. Ann's Square, Manchester, on July 3rd, 1891, the following special resolution was passed, and duly confirmed on July 21st, 1891:—"That the capital of the company be increased to £25,000 by the creation of 2,000 new shares of £10 each."

Birmingham Electric Supply Company, Limited.—The annual return of this company made up to June 10th, 1891, was filed on the 7th ult. The nominal capital is £100,000 in £5 shares. 10,006 ordinary and 1,800 "special issue" shares have been taken up, and upon all the ordinary shares the full amount has been called, while upon the "special issue" shares 5s. per share has been called. The calls paid amount to £49,597 10s., and unpaid to £882 10s. Office, 14, Dale End, Birmingham.

West Coast of America Telegraph Company, Limited.—The annual return of this company made up to May 29th, 1891, was filed on June 4th. The nominal capital is £300,000 in £10 shares. All the shares have been taken up, the full amount called, and all calls paid. Office, 120, Cannon Street, E.C.

CITY NOTES.

Anglo-American Telegraph Company, Limited.

THE ordinary general half-yearly meeting of the proprietors of the above company was held on Friday last at Winchester House, Old Broad Street, the Marquis of Tweeddale in the chair.

The SECRETARY, Mr. T. H. Wells, having read the notice convening the meeting, and the directors' report and accounts, which appeared in last week's ELECTRICAL REVIEW, having been taken as read,

The CHAIRMAN said:—Gentlemen: I have to ask you to adopt the report and accounts which have been in your hands for some time past. The traffic receipts amounted to £136,483 for the half-year, which is a decrease of £8,432 as compared with the corresponding period of last year. The whole amount available for dividend is less by £14,517, and that is made up as follows:—Traffic receipts, to which I have just referred, £8,432; loss on account of chartering the *Minia*, £3,342; while interest on deposit account is £636 less, and the balance brought forward £1,403 less. This, with an increase of expenses which were inevitable, to the extent of £7,136, makes up the sum of £14,517. The 12s. per cent. which we are only able to pay is, of course, not a little discouraging to us; but I do not think anyone will be surprised at this result who has kept his eyes open to the state of affairs, more especially in the commercial world, during the period under review. Not only has our income been adversely affected by stagnation in business, following on the financial difficulties of last autumn, but in other ways our receipts have been reduced. For instance, owing to the interruptions on the West Coast of South America, our traffic has been reduced to the extent of £10,000. I am happy to say, however, that the interruption which so long existed has now been removed, and that our traffic in that quarter has resumed its normal conditions. I only wish that I could add that the depression in commercial circles has disappeared also; still, I think there is no reason to question that that will disappear in the course of time—and in the course of a not very long time, I hope—and then our traffics will again recover their usual proportions. At any rate, gentlemen, I am quite satisfied that we have not suffered in any degree more than our competitors in the Atlantic, nor can our reduced receipts be attributed to any want of activity on our part in securing traffic. The report tells you that we have established new offices in several commercial centres; we have also provided a direct communication between the company's offices at Brest and Havre and the Government offices at the Paris Bourse, and have thus placed ourselves on an equality with our competitors in that country. Canvassing, both at home and abroad, has been pursued with great energy, and I am glad to say with corresponding successful results. I have the return here, which shows what has been accomplished in that way, and I may observe that in one country—in Belgium—our income, as compared with 1890, has about doubled—that is, for the six months. Looking at France, the increase is about 25 per cent., and if we take Southampton, where we have offices, I find that the increase is very considerable indeed. These increases are almost exclusively due to the greater activity on the part of those who are looking after and cultivating the traffic for us. I dare say there are some present who may remember the criticism that was passed upon our company by one of our largest shareholders and customers. He complained that our lines were subject to interruptions in the winter, which greatly interfered with business. Well, gentlemen, I am happy to say that our friends on the Western Union have shown themselves alive to the necessity and importance of placing our connections under their control in a far more satisfactory position. I have a letter here which I do not intend to read the whole of, as it is quite unnecessary, but I may read some portions of it. It is a letter from Gen. Eckert, who is the able manager of the Western Union, who says that he has no hesitation in assuring us that, with regard to the interruptions which occurred last winter, they had taken such precautions, regardless as to their cost, as would prevent any appreciable delay to the business on our side. In addition to that, I may say that the directors have determined to take steps to connect Sydney and Canso by cable, and in this way we shall have a direct communication by submarine cable between England and France and New York, which we have never yet had since our company was established. Gentlemen, I think that if Mr. Leon—the critic to whom I have referred, and whom I am glad to be able to say is now a member of Parliament—if he has time to cast his eye over a report of the proceedings to-day, will be glad to learn that his criticisms have borne fruit in the way which I have just described. The additional facilities which have been thus given to the telegraphing public have not been provided without some additional expense, but our policy has been, and we hope, ever will be, to render our services as efficient as possible, not only in regard to speed—I doubt whether we can do much better in that respect than we are doing now—but in respect to freedom from interruption, and above all, in respect to accuracy, and I may mention that particular attention has, during the past year, been devoted to that matter, and I am pleased to say with very good results. Our cables, you are informed, are in good order generally, the only exception, indeed, being the North Placentia cable, which has given us a good deal of trouble, and which requires some additional cable in order to make it as efficient as it should be. But I hope that by the time I address you again this difficulty will have been entirely removed. The accounts appear to call for no particular comment, because I have already referred to the increased expenditure which has been incurred under the heads of B. and C. (expenses at head office in London and expenses at stations) and have explained that it is almost exclusively due to the improved facilities which I have described. The renewal fund has reached the handsome figure of £990,000 in round figures. It may interest you to know that during the past four and a-half years we have charged the repairs and renewals fund with amounts to the extent of £120,000, being at the rate of £27,000 a year. Our income from the renewal fund has been about £32,000, so that for these years past we have been adding to the renewal fund at the rate of £5,000 a year. I do not think, gentlemen, there is any other point to which I may be expected to call your attention, excepting the interesting question of our suit with the French Company. As there may be some here present who are not acquainted with the history of that case, I have had drawn up a very brief memorandum, showing exactly what has taken place from the beginning. If you will allow me to read it, it will not take long, and it will show you exactly what the position of the case is at present. On December 30th, 1886, M. Granet, Minister of Posts and Telegraphs, wrote to the French Company to the effect that by amalgamating its interests with foreign companies, it had departed from the terms of the concession, and should take steps for observing the same. The next day the French company denounced the agreements on the ground that the minister's letter was an order obliging them to do so. Whereupon proceedings were commenced by us in the Tribunal of Commerce on January 9th, 1888. That Court decided that the French Company must resume the performance of the agreements under a penalty of 5,000 francs per day for every day's delay until the expiration of one month, and adjudged a considerable sum to be paid to this company by way of damage already incurred. The French company appealed from this judgment, and the Court of Appeal, on April 24th, 1888, suspended judgment until competent authority had declared whether the company had correctly interpreted M. Granet's letter. This question of interpretation was submitted, in the first instance, to the Council of the Prefecture of the Seine, which, on March 19th, 1889, declared that M. Granet's letter had been rightly interpreted by the French company. This decision was received by the Council of State on May 1st last, which set aside the order of the Court of Prefecture of the Seine, and determined that the letter in question had not the effect of an order compelling the French company to break the contracts, but that it only amounted to an invitation to the French company to take immediate steps to put itself right according to the conditions of its concession. Since the

date of that judgment, a correspondence has taken place between the French company and its Government, from which it appears that the present Government would not sanction the joint purse agreements. The case will now go back to the Court of Appeal, which will decide, I hope finally, the amount of damages to which this company is entitled through the unjustifiable conduct of the French company. I need hardly say that we shall all await the decision of that Court with great interest. I do not think you will expect me to express any opinion on the subject. There is no doubt that a gross breach of the agreement was committed, but whether the French Government will see fit to give us considerable damages on that account I am not able to predict. I think I have touched on every important matter that has arisen during the past half-year, and I now only express a hope that when we meet again six months hence, the prevailing depression in commercial circles—upon which our fortunes so much depend—will have disappeared, and that I shall be in a position to present to you a more satisfactory report than it has been in my power to do on this present occasion. Gentlemen, I beg to move the adoption of the report.

Mr. F. A. BEVAN seconded the motion.

Mr. SMITH (York) said he should move an amendment to the adoption of the report. The chairman had told them that the amount of traffic decrease for the half-year was £8,432, and he would like to know what proportion of the loss occurred in the first three months of the year, as the directors made the decrease the excuse for the paltry reduction of the dividends paid on the 1st of May of 1s. per cent. on the ordinary and 2s. per cent. on the preferred stocks.

The CHAIRMAN: I mentioned that £10,000 was lost through the Chilian interruption.

Mr. SMITH said that the effect of the reduction of the dividends reduced the market value of the stocks fully from 3 to 4 per cent., and he could only describe such a policy as a beggarly and cheeseparing one. He thought the chairman would agree that the directors were very much to blame in the matter.

The CHAIRMAN: In which matter?

Mr. SMITH: In the matter of reducing the dividend 1 per cent.

The CHAIRMAN: We could only pay what we had got.

Mr. SMITH, continuing, complained that certain expenses incurred in opening up new offices had been charged to revenue, when in his opinion they should have paid out of the renewal fund. He thought the directors had shown a want of consideration for the shareholders. He had gone into the question very thoroughly, and he estimated that the market value of the renewal fund was £1,050,000, and under those circumstances he would suggest that 3½ should be the minimum dividend paid this year, which would give the preference shareholders 6 per cent., and leave a modest 1 per cent. for the deferred stockholders, and that the renewal fund should be used for the purpose. He moved an amendment to that effect.

The CHAIRMAN said he hardly thought such an amendment in order. That was an interim dividend, and the directors had full power over the amount they should declare.

Mr. SMITH thereupon withdrew that part of the amendment relating to the dividend, and simply proposed that the report be not adopted.

Mr. J. BROWN seconded the amendment, and said that as the renewal fund was mainly built up by the deferred shareholders, he thought it was quite time their case was taken into consideration by the directors, seeing that they had had nothing for the last seven years.

Mr. JACKSON complained that although the traffic receipts had been £8,000 less, the expenses at the head office had been £1,208 more than in the half-year ended December last.

The CHAIRMAN explained that the increase was simply due to the payment of salaries, which happened to come into that half-year, but which might have been paid in the previous half.

Mr. JACKSON said he did not think that any of the shareholders could be satisfied with the results. He thought that a company like theirs, which had been in working for 25 years, which was the pioneer company, and which started under extraordinary advantages, should feel humiliated at being beaten by the youngest competitor in the field. The poor results shown by the directors proved that there was need for change somewhere. They had nine directors—in his opinion a totally unnecessary number, and there seemed to be an utter recklessness as to results. Shareholders could not be fed upon hopes; they expected to be fed upon dividends, and certainly after 25 years he thought they ought to have had some better results. If the shareholders remained quiet under such treatment they would never receive any larger dividend. When Viscount Monck was chairman of the company he always led the shareholders to believe that when the renewal fund amounted to £1,000,000 in liquid assets that the interest of that enormous accumulation should be used to increase the paltry dividend that they had received for so many years. He would remind the chairman that the deferred capital represented 40 per cent. of the entire stock of the company, and they had not had one cent. interest for many years. He thought, therefore, it was quite time that the shareholders made some notification of their dissatisfaction, for unless the directors could show better results they should give way to better men.

The CHAIRMAN, in reply, said that, with respect to what percentage of decrease in the traffic receipts occurred in the first three months of the half year, it would be impossible to give an answer to that then, but if Mr. Jackson liked to call at the company's office he could obtain the information. Mr. Smith had announced his intention of voting against the report for several reasons, and one of them was because the cost of new offices had not been taken from the renewal fund but charged to revenue. But surely such a charge as the rent of new offices could only be charged to maintenance. Then he said that a 3½ per cent. dividend should be paid, and that raised the question of the renewal fund. That was a subject that had been discussed very often, and with regard to it he could only repeat what he said at the last meeting. Having regard to the great age of their cables and the necessity some day or another of renewing them, it was necessary that they should have a very substantial reserve. That, he believed, was the correct policy, and one which would commend itself not only to the preferred but to the deferred shareholders. Mr. Smith had said that it could not be true that their cables were getting old, and that they might want renewing. He would remind Mr. Smith that the oldest of their cables was laid in 1869, the next was laid in 1873, the next 1874, while the youngest was laid in 1880. In the face of such facts and of their experience of the Atlantic, they were bound to keep a very handsome reserve in order that it might be always available to keep up their four cables in the Atlantic, to say nothing of their many other smaller cables. As to the full dividend of 3 per cent. being paid, it was almost incredible that Mr. Smith should have put such a proposal forward. As to the value of their stocks having fallen in the market, he was not aware that they had fallen so very much—in fact, what was remarkable about investments in cable securities was the small falls and the slight depreciation that had taken place. Mr. Smith had placed the value of the reserve fund at £1,050,000, but they did not think they would be justified in putting it at higher than £1,029,000, so that there was a difference of £20,000 between them. Mr. Jackson had complained of the success of the Commercial Cable Company. He (the Chairman) was not there to explain that; their duty was to do their best to reduce that success as much as possible. With respect to what Mr. Jackson had said as to the views of Viscount Monck on the renewal fund, he (the Chairman) could only say that Lord Monck was entirely in accord with himself and the rest of the directors as to the advisability of not having less in the reserve than they now possessed. He hoped that after the explanations he had given Mr. Smith would withdraw his opposition.

Mr. SMITH said that he could not accept the Chairman's suggestion, but would feel compelled to vote against the report.

The CHAIRMAN then put the motion to the meeting, when six only voted against it, and the report was adopted by a large majority.

A vote of thanks to the chairman for presiding concluded the proceedings.

The Telephone Company of Austria, Limited.

THE eighth ordinary general meeting of the above company was held on Thursday, July 30th, at the offices, 53, New Broad Street, Mr. Henry Grëwing presiding.

The SECRETARY (Mr. Richard Rodgers) having read the notice convening the meeting, the following report for the year ending March 31st, 1891, was taken as read:—

"There has been expended on capital account a further sum of £8,868 7s. The gross receipts in Austria were £18,513 14s. After providing for all expenses, including £4,418 6s. 2d. for debenture interest, and dividend on preference shares, and £3,520 7s. 6d. for royalties and taxes to the Austrian Government, the profit on the year is £3,438 16s. 2d., which, with the £1,047 2s. 7d. balance from last year, gives a total of £4,485 18s. 9d. to the credit of profit and loss account, which amount it is proposed to carry forward.

"In view of the expiration in October next of some of the company's concessions, negotiations with the Austrian Government as to the future of the company have been in progress for a considerable time past. These negotiations are now approaching their final stage, and the result will be brought to the knowledge of the shareholders without delay. Under these circumstances the board do not recommend at present the payment of any dividend on the ordinary shares.

"The directors have again to report a continued increase in the number of subscribers to the company's exchanges, as shown by the following table:—

	No. of subscribers.	Increase over previous 12 months.	Rental.	Increase over previous 12 months.
March 31st, 1890	2,652	353	210,000 fl.	27,450 fl.
March 31st, 1891	*3,023	371	238,000 fl.	28,000 fl.

* Exclusive of 240 "extension" telephones, which give an additional annual rental of 8,210 fl.

"Installations in the towns are progressing at the usual rate, and, so far as the board can judge, seem likely to continue. The calls of subscribers now average over 97,000 per week, as against 70,000 last year.

"The thanks of the shareholders are again due to Dr. Eugen Weissel for his continued valuable services during the past year, and to Mr. Krause for the very satisfactory manner in which he continues to perform his duties as general manager.

"Mr. Henry Grëwing retires by rotation from the board, but being eligible, offers himself for re-election.

"The auditors, Messrs. Deloitte, Dever, Griffiths & Co., also retire, but being eligible, offer themselves for re-election.

The CHAIRMAN, in proposing the adoption of the report, said: Gentlemen, the figures which you will have seen in the balance sheet show that the profits were sufficient to pay 5 per cent. interest on the debentures, and the 6 per cent. dividend to which the holders of preference shares are entitled, and that after providing for those two charges, a balance is left of £4,485 18s. 9d., which, under ordinary circumstances, would go as dividend to the ordinary shares. The state of prosperity of the company as a company is therefore un-

doubted. I now proceed to the paragraph which refers to the surplus and of the company's future in connection with the negotiations with the Austrian Government. Since this report was issued these negotiations have advanced another step, and a telegram which you may have seen appeared in one of our leading morning papers of Tuesday last, dated Vienna, Sunday night. This telegram gives the position so accurately, that we can hardly doubt that the information was supplied from official sources, and the board, therefore feels called upon to enter into this question fuller than they would otherwise have done, considering the negotiations are still pending. The facts as stated in the telegram are correct, but the expression used that we demanded compensation to the extent of £160,000 is misleading, unless it is stated that we demand this compensation in return for a very heavy capital outlay amounting to about £100,000, in constructing, equipping, and bringing to their present state of perfection the eight exchanges which we possess in the Austrian empire. The telegram might also have added that it was under most trying circumstances that the business was started, and that all the energy, perseverance and resources of the board were required to produce the results attained. These results are well known both to the proprietors and to the Austrian Government, to whom we are now paying some £3,000 per annum in royalties alone, not to mention a large amount in rates and taxes, whilst our revenue, as a result of that large capital expenditure, shows a net profit of some £9,000 per annum, or, adding the royalties, £12,000. This large and prosperous undertaking the Government now wishes to take over, and according to our reading of the purchase clause in the concessions—a reading which is also shared by one of the most eminent lawyers in Vienna—the basis for fixing the purchase price is the amount of net revenue for the year preceding the purchase. The Government, however, interprets the concession clause differently, and insists that it only applies during the continuance of the concession, and not after it has come to an end, which it will do on the 14th of October next, the argument being that as the company would have to stop business on the 14th October, the revenue ceases, and could scarcely be taken as a basis. Such is the present legal aspect of the matter, but we have it from the present Minister of Commerce himself that the question will be viewed by him from an equitable point of view, and we are sure that his Excellency will be the first to admit that a concession for so short a time as ten years cannot possibly give to those who work it an opportunity of recouping themselves out of the profits for their outlay of capital. His Excellency will also admit that this new and exceedingly valuable means of communication as introduced by us into Austria has not only met with the strong support of the public, but that the very fact of its having met the public interest, and, at the same time, brought in an ever-increasing revenue to the State, has determined the Government to acquire it for the State. I may say that neither money nor pains have been spared to make the service one of the best, if not the best in Europe, and that the authorities themselves have freely expressed their satisfaction with us on the subject, and commended us in an official document as recently as January last for the loyalty with which we have served both the public and the State. I may also add that to construct and equip afresh what we have constructed and equipped in the eight towns would cost the Government not less than the sum we are now asking for, not to mention that it would take at least from three to five years to get the whole of the exchanges in such perfect working order as they are in now. Our demand, therefore, is moderate compared with the anxiety and labour which we have undergone to accomplish the results. Under these circumstances, your board refuse to believe that the Government will deal otherwise than honestly and equitably with us, and that this opinion also strongly prevails in influential quarters in Austria, as shown by the concluding words of the speech by Dr. Russ when reporting on behalf of the Parliamentary Committee on the subject, he said: "I am of opinion that the private capital invested in good faith and honestly employed should experience no damage through the acquisition by the State." We are most ably represented in Vienna by Dr. Eugen Weissel and Mr. Krause, but in order to give every support to the negotiations which have been carried on, three of your directors have recently visited Vienna in order to lend their aid towards a satisfactory settlement. I may say that the Government have made an actual offer, which, however, is unacceptable, and some of your board have therefore determined to again proceed to Vienna in order to facilitate an understanding. You will gather from these observations that nothing will be wanting on our part to conduct this difficult business in the most friendly way possible, and as the Government of Austria can possibly have no desire to frighten English capital out of the country, it is to be hoped that they will protect all such capital from undeserved attacks. I now move: "That the report and accounts of the company for the twelve months ending March 31st last, as now presented, be received and adopted."

Mr. C. L. W. FITZGERALD seconded the motion, which was carried unanimously.

Mr. FITZGERALD then proposed the re-election of the chairman as a director. Mr. Grëwing had, he said, been associated with the company for many years, and he was a most valuable director.

The motion having been seconded was carried, as was a resolution re-appointing Messrs. Deloitte, Dever, Griffiths & Co. as auditors.

Mr. ARTHUR BAKER, in proposing a vote of thanks to the chairman and directors, said that from the remarks made by Mr. Grëwing, the shareholders might rest assured that no stone had been left unturned by the directors to bring the negociations with the Austrian Government to a satisfactory settlement, and he felt certain that some arrangement would ultimately be arrived at which would be satisfactory to both parties.

The motion was carried with acclamation.

The CHAIRMAN briefly replied to the vote, and the proceedings terminated.

Manchester Edison-Swan Company, Limited.

THE ninth ordinary general meeting of the proprietors of the Manchester Edison-Swan Company, Limited, was held on 29th ult., at the Victoria Hotel, Manchester. Mr. V. K. Armitage, chairman, presided.

In moving the adoption of the report, an abstract of which was published in the ELECTRICAL REVIEW of last week, the CHAIRMAN stated that since their last meeting in February the directors had tendered for one or two large installations, but seeing they would not get much out of the contracts, they had allowed the tenders to fall through. Just now they were not tendering for any large central lighting installation. The directors had come to the conclusion that at all events some little of their money could be spent very well in another line of business. Mr. Williamson, their former managing director, had to go some eighteen months ago to Australia for the benefit of his health. Some of the directors of this company formed a small company to establish Mr. Williamson in business in Sydney. Before he had been in Australia twelve months business increased so rapidly with him that the capital threatened to become but as a drop in the bucket compared with what was required. The directors of the Edison Company who were not connected with the Williamson Company, and those who were, had this subject thoroughly before them, and seeing that Mr. Williamson had got magnificent electric lighting orders on hand, and was likely to have others from Australian corporations, they resolved upon taking from the bank £2,500 which was lying idle, and purchasing with it shares in the Williamson Company. He (the chairman) looked forward to the employment of a great deal of their money in Australia, but they might rely upon the directors using extreme caution in all such investments. They would not send any money out there unless there was a chance of its being profitably employed. At the meeting of this company, in February last, they were in hopes that the Corporation of Manchester were nearer than now seemed to be the case to a decision on their electric lighting order. They had obtained a provisional order which rendered it necessary for them within a limited time to do a certain minimum amount of work. That time was running on, but they heard nothing clearly as to the carrying out of the order, and he had begun to look less favourably than he once did upon their company's chance of obtaining the Manchester Corporation's central lighting. In the meantime the corporation had determined upon lighting with the electric light the Town Hall, which was outside the area of their compulsory order. The company had tendered for the separate installation that was to be put into the Town Hall, and although a number of other firms had tendered for the same work, he believed they stood as well in as any of the others. He did not know whether the corporation meant to run the installation themselves or to contract for it, but he sincerely believed the lighting of the Town Hall by electricity would be such an improvement upon the present illumination of the building that the corporation would be encouraged to go on extending the electric light in future.

Mr. I. C. WATERHOUSE seconded the adoption of the report.

Mr. CHAS. AGNEW submitted that the directors should at least have consulted with the shareholders before they had invested money in another company, whether under the ægis of Mr. Williamson or anybody else. He believe they were organised to carry on business in this country and not in the Antipodes.

Mr. BECHER took a similar view. The directors might have the power to do as they had done, but he thought such power was most extraordinary.

The CHAIRMAN, in reply, said both the shareholders who had just spoken were mistaken. The company was called the Manchester Company because a certain district was allotted to them, within which they had a monopoly of the Edison-Swan patents. But from the beginning they had been doing work all over the world—in Newfoundland, India, Russia and Portugal. They sold electrical stuff to any human being wherever he lived if he would pay them a reasonable profit. The hands of the directors had never been tied in that matter. Everything that Mr. Williamson had to buy in England he bought from them, and the directors wisely concluded that it would be wrong to allow his business to be lost to them. They had bought shares in the same way in the Elwell-Parker Company some years ago, and afterwards realised them at a handsome profit. The directors had every reason to be convinced of the soundness of their present investment.

The report was then passed, and formal resolutions were adopted declaring the dividends as detailed in the report. Mr. F. B. Ross was elected a director, and the directors' appointment of Mr. Fawcus as managing director was confirmed. The directors' remuneration was fixed at £150, and Messrs. Jones, Crewdson, & Co. having been re-elected auditors, the meeting closed with a vote of thanks to the chairman and the directors for their services.

United River Plate Telephone Company, Limited.

REPORT of the directors presented to the shareholders at the fifth ordinary general meeting, held at Winchester House, 50, Old Broad Street, London, E.C., to-day at 12 o'clock noon.

The result of the company's operations during the year ending March 31st last, after paying all working expenses abroad, debenture interest, London and other charges, is a profit of £38,480 14s. 4d., from which is to be deducted the sum of £36,049 0s. 8d. for loss on exchange, leaving a net profit of £2,431 13s. 8d., to be increased by the balance of £2,373 16s. 6d. brought forward from the previous year, to £4,805 10s. 2d.

Out of this, the directors recommend that £768 7s. 8d. be applied

in writing off one-half of the taxes suspense account, and £2,000 be written off for bad and doubtful debts in the River Plate, and that the balance of £2,037 2s. 6d. be carried forward to the credit of profit and loss account for the current year.

As shown in the balance sheet, the capital expenditure during the year amounted to £3,096 10s. 10d. as against £12,772 8s. in the previous twelve months.

It will be observed from the profit and loss account, that nothwithstanding the revolution in July, 1890, and the continued crisis in the River Plate, which has practically stopped the Company's sales business, the gross receipts for the year are £106,259 19s. 8d. as compared with £108,612 2s. 7d. in the year before.

The loss on exchange, £36,049 0s. 8d., represents nearly 12½ per cent. on the company's paid up share capital.

The working expenses in the River Plate amount to £56,941 1s. 9d. against £63,497 15s. 5d. during the previous year, and the London expenses to £2,732 14s. 9d. against £3,257 15s. 6d. Since the close of the year the London expenses have been still further reduced by about one-third.

The directors greatly regret the loss by death of their late colleague, Mr. John Coghlan, in September last, and that Lord Thurlow, owing to pressure of other engagements, resigned the chairmanship in April; in the place of Mr. Coghlan the directors elected Mr. Unwin, on his retirement from the secretaryship in March last.

Under the articles of association Mr. John Irving Courtenay and Mr. John Owen Unwin retire by rotation, and being eligible, offer themselves for re-election.

The auditors, Messrs. Cooper Brothers & Co., also retire, and offer themselves for re-election.

The Telephone Company of Ireland, Limited.

THE twelfth ordinary general meeting of the Telephone Company of Ireland, Limited, was held on the 29th ultimo, at the offices of the company, Commercial Buildings, Dame Street, Dublin. Alderman V. B. Dillon, chairman, presided.

The directors' report and statement of accounts set forth that:—

The number of wires, exchange and private, under rental upon December 31st, 1889, was 1,309. On December 31st, 1890, the number was 1,473, being an increase of 164 for the year. The company having been placed in possession of the requisite funds, are now, in conjunction with the National Telephone Company, Limited, proceeding as rapidly as possible with the erection of the Trunk Lines not only to connect the Telephone Exchanges of Dublin and Belfast, but also to afford telephonic conveniences to the intermediate towns. It is expected that the lines will be open to the public on October 1st next. In view of the increase in the number of subscribers, and in the number of calls, and of the large increase it is expected will accrue from the connection of the Telephonic Exchanges of Dublin, Belfast, and intermediate towns, together with the establishment of new exchanges on the Northern lines, it will be necessary to entirely remodel the Dublin centre. For this purpose a convenient site has been obtained, upon favourable terms, from the Corporation of Dublin; and within the current year plans will be matured to afford the necessary accommodation. It will be observed that the amount standing to the credit of the net revenue account as upon December 31st, 1890, including the balance brought from last account, amounts to £4,950 10s., against £4,459 4s. 10d. for the year 1889. Out of this sum there has been paid an interim dividend upon the preference shares for the half-year ended June 30th, 1890 (£1,137 17s. paid in July last), leaving an available balance of £3,812 13s., as shown in the balance-sheet, which the directors propose to allocate as follows: For the payment of the debenture interest, £49 4s. 3d., for the payment of balance dividend upon the preference shares for the second half of the year (£1,153 1s. 8d.), and to place to the credit of the reserve fund £464 13s. 6d. (being 10 per cent. of the net profits of the year), carrying forward the balance of £2,145 13s. 7d. to the credit of the current year.

The CHAIRMAN said it was his pleasure to move the resolution in reference to the report—namely, that the report and accounts of the directors submitted to the meeting be taken as read, received, and adopted. The report was a full one, and did not require much explanation from the chairman of the company. He should like to note one or two matters which they considered of very great importance as showing the advance which telephone work is making in the country. The number of their wires, exchange and private, have increased for the year ending December, 1890, by 164, or something about 15 per cent., notwithstanding that in Dublin they had a serious accident at the end of last year which caused a very serious interruption to the traffic on the line. It is very satisfactory to say to the shareholders that the expenses incurred in their partial reconstruction were defrayed without resorting to capital. They expected this year to make a very considerable step in advance by the opening of the exchange wire between Dublin and Belfast. This, they anticipate, will be completed, before October 1st. As arranged, the tariff from Dublin to Belfast will be fixed at 1s. for a message lasting for three minutes—that is, a person communicating with Belfast who now can send a telegram which will cost 6d. for 12 words, and receive a reply costing 6d. more for 12 words—1s. in all—will now have an opportunity of exchanging for the same rates, 1s., his views with his correspondent in Belfast to the extent, if he speaks fast enough, of something like 300 words. That they considered to be a very important development. The tariff from Dublin to towns inside their district, including the county of Louth—having in it the towns of Dundalk and Drogheda—will be only 6d., that is, 3d. for the message each way. Of course, they cannot predict what may result from the opening up of such a new system as that; but if they were to judge by the number of telegraphic messages which passed between Dublin and Belfast and intermediate towns, the results, indeed, will be very satisfactory to the company for the small outlay of capital which has had to be made. They have been able to arrange, as the report shows, for the working capital for this development and for the general business of the company on satisfactory terms. In conclusion, he said their accounts show very satisfactory results of the working of the company, and they hoped they would meet with the approbation of the shareholders.

Mr. DUDGEON seconded the adoption of the report which was then declared carried.

The CHAIRMAN then moved that Mr. Gilbert Cockburn be elected a director of the company. Since last meeting one of the members of the board, Mr. Erichsen, died, and another, Mr. Robert Worthington, found that his other business absorbed his attention so much that he was unable to devote any time to the affairs of the company. They had been fortunate in securing the services of Mr. Cockburn, whose business capacity is well known.

Mr. DUDGEON seconded the motion.

Mr. Cockburn was declared elected.

Mr. John M'Kean having been re-appointed auditor, the meeting adjourned.

City and South London Railway Company.

REPORT of the directors for the half-year ending June 30th, 1891, to be submitted to the half-yearly ordinary general meeting of the company, to be held at Winchester House, Old Broad Street, E.C., on Tuesday, August 11th, 1891:—

In presenting their report the directors have to report with satisfaction that the railway has been worked, during that period, without accident to any passenger, or to any of the staff employed. Although occasional delays to the traffic have occurred through defects in the rolling stock, or other similar causes, these were at first to be expected during the working of a new and untried system of locomotion, and it is a matter for congratulation that in all these cases the delay has been of very short duration, and the regularity of the working is steadily improving.

The receipts during the half-year from all sources amount to £19,688 2s. 4d., and the expenses for the same period to £15,520 16s. 5d. leaving a net profit of £4,167 5s. 11d. The net revenue account shows a balance of £4,693 3s. 8d., of which amount the interest on debentures absorbs £4,137 16s. 6d., leaving a balance of £555 7s. 2d. to be carried forward to the next account. In the beginning of a new undertaking, many of the items of expenditure are necessarily high, but your directors have satisfaction in stating that some of these have already been considerably reduced, and further reductions will from time to time be made, so far as is consistent with the safety of the public, and the interests of the company. During the half-year the number of passengers carried by the railway has been 2,412,343. For a considerable time an uniform charge of twopence for passengers was adhered to, but it has been found necessary, in order to compete with the omnibus and tramway traffic, to reduce the charge at certain stations to one penny during stated hours. This has been found to work advantageously, both in the company's interest, and to the convenience of the public. Two additional locomotives are now nearly ready, and one train of the new carriages has already been received. The completion of these, and the additional generating engine and dynamo now in course of construction, will allow of a considerable increase in the train service.

The action taken by the London County Council in Novemher last to contest the right of the company with respect to the line of frontage at Kennington and the Oval stations has been decided in favour of the company, by the Court of Appeal. The Bill promoted by the company in Parliament for an extension of the line to Islington, failed to pass the committee of the House of Commons, and the directors regret that a valuable aid to the traffic of the existing line, and a great accommodation to the public has been in consequence delayed.

The directors regret that owing to other engagements, Mr. Walter Robinson has decided to resign his seat at the board, and the vacancy so created has been filled by the election of Mr. S. Barclay Heward, of 57, Old Broad Street, London.

TRAFFIC RECEIPTS.

The Brazilian Submarine Telegraph Company, Limited. The receipts for the week ending August 1st, amounted to £5,152.

The City and South London Railway Company. Traffic receipts for the week ended August 1st, were £692 gross.

The Cuba Submarine Telegraph Company, Limited. The estimated traffic receipts of the Cuba Submarine Telegraph Company, Limited, for the month of July, were £3,100, as compared with £3,134 in the corresponding month of last year.

The West India and Panama Telegraph Company. The receipts for the two weeks ended July 31st show a decrease of £644 as compared with the corresponding month of last year.

Direct Spanish Telegraph Company, Limited. The estimated traffic receipts for the month of July, 1891, are £1,667, as against £2,016 in the corresponding period of last year.

The Great Northern Telegraph Company. Receipts in July, 1891, £24,400; 1st January to 31st July, 1891, £165,800; corresponding months 1890, £156,000; corresponding months 1889, £154,200. The reduction in the rates which was agreed upon at the Telegraph Conference in Paris, come into force on July 1st.

The West Coast of America Telegraph Company, Limited. Traffic receipts for the month ending July 31st, 1891, were £2,075.

The Western and Brazilian Telegraph Company, Limited. The receipts for the weeks ending July 17th and 24th, 1891, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Company were £3,280 and £3,319 respectively.

The Eastern Extension, Australasia, and China Telegraph Company, Limited. —The traffic receipts for the month of July amounted to £41,219, as gainst £46,567 in the corresponding period of 1890; and those of the Eastern Telegraph Company to £59,908, as against £54,294.

SHARE LIST OF ELECTRICAL COMPANIES.

Present Amount Issued.	Name.	Stock or Share.	Closing Quotation. (July 30).	Closing Quotation. (August 6.)	Business done during week ending August 6, 1891. Highest.	Lowest
250,000*l*	African Direct Telegraph, Ltd., 4 p. c., Deb. Regd. and to Bearer	100	98 —101	98 —101	98	...
1,381,380*l*	Anglo-American Telegraph, Limited	Stock	43 — 44 xd	43 — 44 xd	43½	42⅝
2,809,310*l*	Do. do. 6 p. c. Preferred	Stock	82½— 83½xd	82 — 83 xd	83½	82½
2,809,310*l*	Do. do. Deferred	Stock	9½— 10	9½— 10	10	9⅝
130,000	Brazilian Submarine Telegraph, Limited	10	11⅜— 12¼	11⅜— 12¼	12⅛	12
84,500*l*	Do. do. 5 p. c. Bonds	100	101 —104	99 —102 xd	...	...
75,000*l*	Do. do. 5 p. c., 2nd Series, repayable in June, 1906 ...	100	103 —107	103 —107	...	...
63,416	Brush Electrical Engineering Ordinary, Nos. 1 to 63,416	3	2⅜— 2⅝	2⅜— 2⅝	2⅜	2 5/16
63,416	Do. do. Non cum. 6 p. c. Preference, Nos. 1 to 63,416	2	1⅜— 2	1⅜— 2	1 11/16	1 11/16
50,000	City and South London Railway, Nos. 1 to 50,000	10	4 — 5	3 — 5	...	...
$7,216,000	Commercial Cable, Capital Stock	$100	105 —109	105 —109	107⅞	107½
224,850	Consolidated Telephone Construction and Maintenance, Limited ...	14/-	7/16— 9/16	7/16— 9/16	...	...
20,000	Crompton & Co., Ltd, 7 p. c. Preference Shares, Nos. 1 to 20,000	Stock	4 — 5 xd	4 — 5 xd	...	...
16,000	Cuba Telegraph, Limited	10	10½— 11½	10½— 11½	...	...
6,000	Do. do. 10 p. c. Preference	10	17 — 18	17 — 18	...	...
12,931	Direct Spanish Telegraph, Limited, ... (£4 only paid)	5	3½— 4	3⅜— 4¼	3⅜	...
6,000	Do. do. 10 p. c. Preference	5	9 — 10	9 — 10	...	...
60,710	Direct United States Cable, Limited, 1877	20	10⅜— 10⅝xd	10⅜— 10⅝xd	10 11/16	10 7/16
400,000	Eastern Telegraph, Limited, Nos. 1 to 400,000	10	14⅝— 14¾	14⅝— 14⅝	14 15/16	14⅜
70,000	Do. 6 p. c. Preference	10	15 — 15½	15 — 15½xd	15½	15⅛
200,000*l*	Do. 5 p. c. Debs. (1879 issue), repay. August, 1899	100	108 —111	106 —109 xd	...	...
1,200,000*l*	Do. 4 p. c. Mortgage Debenture Stock	Stock	106 —109	106 —109	...	...
250,000	Eastern Extension, Australasia and China Telegraph, Limited ...	10	14⅞— 15⅛	14⅜— 15	15 1/16	14⅜
91,800*l*	Do. 5 p. c. (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	102 —105	102 —105	104½	104
325,200*l*	Do. do. Bearer Nos. 1050—3,975 and 4,327—6,400 ...	100	101 —104	101 —104	103	...
320,000*l*	Do. 4 p. c. Debenture Stock	Stock	104 —107 xd	104 —107 xd	106	...
135,000*l*	Eastern and South African Telegraph, Ltd., 5 p. c. Mort. Deb. 1900 redeem. ann. drawings, Registered Nos. 1 to 2,343	100	101 —104	101 —104	102¼	...
180,400*l*	Do. do. do. to bearer, Nos. 2,344 to 5,500	...	101 —104	101 —104	...	...
201,600*l*	Do. do. 4 p. c. Mort. Debs. Nos. 1 to 2016, red. 1909	100	99 —101	99 —101 xd	99¾	98¼
45,000	Electric Construction, Limited, Nos. 101 to 45,100	10	3 — 4	3½— 4½	4	...
19,900	*Electricity Supply Co. of Spain, Nos. 101 to 20,000	5	4½— 5	4½— 5	...	...
66,750	Elmore's French Patent Copper Depositing Co., Ltd, Nos. 1 to 66,750	2	2⅝— 3	3 — 3¼	3⅛	2⅝
70,000	Elmore's Patent Copper Depositing, Limited., Nos. 1 to 70,000 ...	2	3¾— 4	3⅝— 3⅞	4 1/16	3¾
67,385	Elmore's Wire Mfg., Ltd., Nos. 1 to 67,385, issued at 1 p.m., all pd.	2	1⅛— 1⅜	1⅛— 1⅜	...	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300 ... (£4 10s. only paid)	5	2 — 3	2 — 3	...	...
180,227	Globe Telegraph and Trust, Limited	10	9⅝— 9⅞xd	9⅝— 9⅞xd	9⅞	9 11/16
180,042	Do. do. 6 p. c. Preference	10	14⅝— 15⅛xd	14⅝— 15⅛xd	15⅛	14⅝
150,000	Great Northern Tel. Company of Copenhagen	10	18½— 18⅝	18½—19	...	...
230,000*l*	Do. do. 5 p. c. Debs. (issue of 1883) ...	100	105 —108	105 —108	...	...
9,334*l*	Greenwood and Batley, Ltd., Ordinary, Nos. 4667 to 14,000 ...	10	8 — 8½	8 — 8½	...	...
5,334*l*	Do. 7 p. c. Cumulative Preference, Nos. 2,667 to 8,000	10	10 — 11	10 — 11	...	...
41,600	India-Rubber, Gutta Percha and Telegraph Works, Limited ...	10	18½— 19½	19 — 20	19⅜	19¼
200,000*l*	Do. do. 4½ p. c., Deb., 1896	100	103 —105	103 —105	...	...
17,000	Indo-European Telegraph, Limited	25	39 — 41	39 — 41	...	...
11,334	International Okonite, Ltd., Ordinary Nos. 22,667 to 34,000	10	7½— 8½	7½— 8½	...	...
11,334	Do. do. Preference Nos. 5,667 to 17,000 ...	10	9¼— 9¾	9¼— 9¾	...	...
38,348	London Platino-Brazilian Telegraph, Limited	10	6½— 7⅛	6½— 7⅛	...	...
100,000*l*	Do. do. do. 6 p. c. Debentures	100	106 —109	106 —109	...	...
43,900	*Metropolitan Electric Supply, Ltd., Nos. 6,101 to 50,000 (£9 paid)	10	9⅜— 10¼	9⅜— 10¼	10	9⅛
438,984	National Telephone, Limited, Nos. 1. to 438,984	5	4⅜— 5	4⅜— 4⅞	4 15/16	4⅜
15,000	Do. 6 p. c. Cum., 1st Preference	10	12½— 13½	12½—13½	13⅛	12⅞
15,000	Do. 6. p. c. Cum. 2nd Preference	10	12½— 13	12½— 13	...	...
350,000	Do. 4½ p.c. Deb. Stock Prov. Certs. fully paid ...	...	105 —107	105 —107	106¼	106
6,318*l*	Notting Hill Electric Lighting Company, Limited, £8 paid ...	10	3½— 4½	3½— 4½	...	...
220,000	Oriental Telephone, Ltd., Nos. 80,001 to 300,000 (11s. only paid)	1	3/16— 5/16	3/16— 5/16	...	...
9,000	Reuter's Limited	8	8 — 8½	8 — 8½	...	...
18,680	St. James's & Pall Mall Electric Light Co., Ltd., Ord., 101—18,780	5	6½— 7	6½— 7	7	6 15/16
7,900	Do. do. do. 7 per cent. pref.	2	3½— 3¾	4¼— 4⅜	...	...
3,381	Submarine Cables Trust	Cert.	115 —120	115 —120	...	...
78,949	Swan United Electric Light, Limited ... ... (£3½ only paid)	5	4½— 5	4½— 5	4⅓	...
37,350	Telegraph Construction and Maintenance, Limited	12	44 — 46	44 — 46	45½	44¼
150,000*l*	Do. do. do. 5 p. c. Bonds, red. 1894	100	101 —104	101 —104	...	...
58,000	United River Plate Telephone, Limited	5	2 — 3	2 — 3	...	...
146,128*l*	Do. do. 5 p. c. Debenture Stock ...	Stock	85 — 95	85 — 95	...	...
3,200*l*	Do. do. 7 p. c. Debs., Nos. 1 to 1,000 ...	100	... ...	... ...	...	...
15,609	West African Telegraph, Limited, Nos. 7,501 to 23,109	10	8 — 9	8 — 9	...	...
290,900*l*	Do. do. do. 5 p. c. Debentures	100	96 — 99	96 — 99	...	...
30,000	West Coast of America Telegraph, Limited	10	3 — 4	3 — 4	...	...
150,000*l*	Do. do. do. 8 p. c. Debs., repayable 1902 ...	100	97 —102	97 — 102	97½	...
64,174	Western and Brazilian Telegraph, Limited	15	10¾— 11¼	10⅝— 11¼	11	...
27,873	Do. do. do. 5 p. c. Cum. Preferred	7½	6¾— 7	6¾— 7	6⅞	6⅝
27,873	Do. do. do. 5 p. c. Deferred	7½	4¼— 4⅝	4¼— 4⅝	4⅝	4 7/16
200,000*l*	Do. do. do. 6 p. c. Debentures "A," 1910 ...	100	104 —107	101 —104 xd	...	...
250,000*l*	Do. 6 p. c. Mort. Debs., series "B" of '80, red. Feb., 1910	100	103 —106	100 —103 xd	106	...
88,321	West India and Panama Telegraph, Limited	10	1¾— 2¼	1⅞— 2¼	1⅞	...
34,563	Do. do. do. 6 p. c. 1st Preference ...	10	10 — 10½	10 — 10½	...	...
4,669	Do. do. do. 6 p. c. 2nd Preference ...	10	9 — 10	9 — 10	...	...
$1,336,000	Western Union of U.S. Tel., 7 p. c. 1st Mortgage (Building) Bonds	$1,000	117 —122	117 —122	...	...
175,100*l*	Do. do. 6 p. c. Sterling Bonds	100	101 —105	101 —105	...	104
42,853	*Westminster Electric Supply Corp., Ord., Nos. 101 to 42,953 ...	5	4⅜— 5¼	4⅜—5¼	5¼	5⅛

* Subject to Founders' Shares.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Blackpool Electric Tramway Company, Limited, £10 (£6½ paid), 7¼—7⅜.—City of London Electric Lighting (Pioneer), Shares of £50, fully paid, 60—62.—Ordinary of £10 each, £2 paid, 2.—Elmore's Austrian Copper Depositing, 15s., 25s., £2 share issued at 10s. prem., fully paid, 1—1¼.—Elmore's Priorities, 3¾—4⅛.—House to House Company (£5 paid) 3¾—4¼.—Liverpool Electric Supply, £3 paid, 2⅝—2⅞.—London Electric Supply Corporation, Ordinary (£5 paid), 2—2¼.—Manchester, Edison and Swan Company, £9 (£1 paid) 2s 6d.—5s.—National Telephone Debentures, 2½—3 prem.—Woodhouse and Rawson Ordinary of £5 (£2 10s. paid), 2¼—2⅜.—£5 Preference, fully paid 3⅞—4¼.—Debentures 90—95.—Wards Electric Car, £10 paid, ⅜—1.

BANK RATE OF DISCOUNT.—2½ per cent. (2nd July, 1891).

THE ELECTRIC TRANSMISSION OF POWER.*

By GISBERT KAPP.

Lecture II.—Delivered February 23rd, 1891.

FUNDAMENTAL PRINCIPLES.

The fundamental principle on which the electric transmission of power depends is that peculiar, and, I might almost say, mysterious interaction between magnets and currents, which we comprise under the name electro-magnetic induction; but more particularly two special cases of electro-magnetic induction, the one discovered by Oersted and the other by Faraday. Oersted discovered that, under certain conditions, a compass needle is deflected by an electric current, and Faraday discovered that relative motion between a magnet and a closed conductor will, under certain conditions, produce a current of short duration in the conductor. Oersted's effect is a permanent one; the needle remains deflected as long as the current flows. Faraday's effect is transient; the current flows, not as long as the magnet is present, but only during the time that it takes to change the relative position of magnet and closed conductor.

It is clear that in Oersted's experiment, the movement of the needle is due to the action of a mechanical force between the magnet and the coil. In Faraday's experiment the transient current must be caused by a transient electromotive force, and this, in its turn, is caused by the relative movement between the coil and magnet. The modern method of explaining these things is based on the conception of magnetic lines of force, and the looping of these lines with the wire coil through which the current flows. The whole subject has been so admirably laid before this Society in the Cantor Lectures on the Dynamo, which Prof. S. P. Thompson delivered here in 1882, that I need not occupy time by going over the same ground again, but may take it for granted that you are familiar with the lines of force theory. In modern language we may therefore explain the two fundamental phenomena somewhat as follows:—

1. The looping of a current with magnetic lines of force sets up a mechanical force between the conductor and magnet (or its equivalent).

2. Relative movement between a magnet (or its equivalent) and a wire coil sets up in the latter an electromotive force.

It follows immediately from these two propositions that looping and movement combined will require the expenditure of power, or yield power, accordingly as the movement is opposed to or in the direction of the mechanical force produced by the looping. In other words, that we can, by these simple means, convert mechanical into electrical power, or electrical into mechanical power. If we carry out both processes at the same time, that is, if we combine Faraday's with Oersted's experiment, we require, of course, a pair of wires between the two converting instruments. In Faraday's experiment, if we thrust the steel magnet into the wire coil, we expend mechanical power, which is converted into the electrical power represented by a current flowing under a certain, though in this case very small, potential difference. The power represented by this current is again reconverted in Oersted's experiment into mechanical power, which is used to produce the deflection of the magnet. The total amount of power thus transmitted from one place to another is, of course, exceedingly small, but the same principle, applied on a larger scale, effects the transmission of many horse-powers, and it will be my task to show you how this is done in practice.

Before entering upon this subject, I must explain an expression used, in stating the fundamental principles on which the electric transmission of power is based. I said that we require a coil and a magnet "or its equivalent." The equivalent of a magnet is, as you know, a coil through which a current flows, and the experiments ought therefore also to succeed if instead of the magnet we use such a coil. In practical work we use neither a steel magnet nor a coil alone, but a combination of a coil with an iron core constituting what is known as an electro-magnet.

You know that according to our modern conception of magnetic fields, there emanates from each pole of a magnet a certain flow of lines of force; and when we thrust a magnet into a coil we cause the individual wires of the coil to cut through the lines of force. The quicker the movement, that is to say, the more lines of force are cut by each wire in unit time, the greater is the E.M.F. produced; and the more wires are contained in the coil the greater is the E.M.F. produced, since the E.M.F. impulses of the different convolutions are added. It is also easily seen by experiment that the stronger the magnet the greater will be the E.M.F.; so that we find that the E.M.F. is proportional to the product of strength of field, speed of cutting, and length of conductor. Denoting these quantities respectively by H, v, and l, the E.M.F. produced is in C.G.S. units $H\,v\,l$, and remembering that a hundred million C.G.S. units of E.M.F. are equivalent to one volt, we have the E.M.F. in volts given by the expression

$$\text{Volts} = H\,v\,l\,10^{-8}.$$

In this formula the strength of field is given in lines per square centimetre and speed and length are given in centimetres.

The mechanical force experienced by a conductor in the neighbourhood of a magnet pole is, according to our modern views, due to the fact that the conductor is laid across the lines of force emanating from the magnet pole. The force in dynes is given by the product, $H\,c\,l$, c being the current. Since there are 981,000 dynes required to represent the force of one kilogramme, and since the C.G.S. unit of current is 10 ampères, we have the force produced by a current of c ampères—

$$\text{Kilogrammes} = \frac{H\,c\,l}{9{,}810{,}000}$$

These are the two fundamental equations required in the design of plant for the electric transmission of power. Now let us see what is the most simple kind of plant we could possibly employ. At the generating station we require a conductor cutting lines of force; this conductor must be joined by wires with a similar conductor at the receiving station. The second conductor is also laid across lines of force, so that when a current passes it will be acted upon by a mechanical force displacing it parallel to itself and doing work. The arrangement here described is shown in fig. 1, where the lines, R

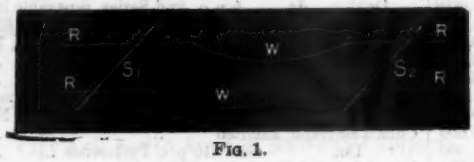

FIG. 1.

represent fixed, horizontal, parallel rails, across which are laid sliding rails, or sliders, s_1, s_2. Imagine the magnetic lines of force passing vertically between the fixed rails, then, if we displace the slider, s_1, an electromotive force will be set up in it, causing a current to flow through the connecting wires, W, and the slider, s_2, at the receiving station. The slider, s_2, is supposed to be laid across lines of force, and will, therefore, be acted upon by a mechanical force. Thus, power may be electrically transmitted from the slider, s_1, to the slider, s_2. It will immediately occur to you that the experiment I have here illustrated could easily be tried by means of any railway. The fixed conductors and connecting wires would be the rails; the generating slider would be a crowbar thrown across them, and hauled along by a train; and the lines of force would be supplied by the vertical component of terrestrial magnetism. At another part of the railway—possibly miles away—another crowbar thrown across the rails should then be set in motion, by the current passing through it. Theoretically, such an arrangement represents correctly enough the electric transmission of power; but, I need hardly tell you that it would not work in practice. If you apply the E.M.F. formula I have given to this case, you will find that, even if the slider is hauled along at the speed of an express train, there will only be generated about the one-thousandth part of a volt, the reason being that the magnetic field provided for us by nature is so extremely weak. If we could apply an artificial magnetic field of the strength generally employed in dynamo machines—that is, about 10,000 times as strong as the vertical component of terrestrial magnetism—then we could get about 10 volts in our slider. Now, it is obvious that we can not spread so strong a field over miles of railway; and we must, therefore, alter our arrangement This may be done as indicated in fig. 2, where one of the rails has been re-

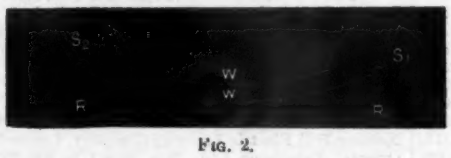

FIG. 2.

placed by a centre contact, and the other by a circular conductor. The slider, instead of being moved parallel to itself, must now revolve round the centre contact, which can easily be done by a belt and pulley. We have thus arrived at what is known as a non-polar dynamo. But even this arrangement, although very much better than the progressive slider, is not of practical value for power transmission, because the E.M.F. of non-polar dynamos is still too low. It is only a few volts, whereas we require hundreds, or even thousands, of volts to carry the current to any distance. The obvious remedy is to use a large number of revolving sliders, so connected that the E.M.F. generated in each shall be added; in other words, instead of a non-polar dynamo, we must use an ordinary continuous current dynamo, wound for high E.M.F. This arrangement is shown in fig. 3, where G_1 is the generator

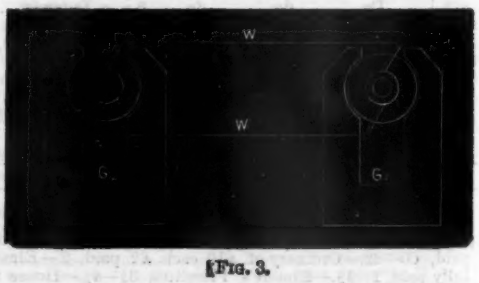

FIG. 3.

and G_2 the motor or receiving dynamo. If you connect their brushes, as shown in the diagram, and rotate the armature of the generator, a current flows through it, the line wires, W, and through the armature of the motor, and exerts upon the latter a mechanical force, tending

* Cantor Lectures.

to produce rotation and give off mechanical power. I am able to show you this experimentally, by means of two dynamos connected, as shown in fig. 3.

The Machines Employed in Power Transmission.

This experiment has shown how power may be transmitted electrically. Let us now consider somewhat more in detail the different parts of the transmitting plant. At one end of the line of transmission we have the generating dynamo, at the other we have the motor dynamo, and then we have the line itself, consisting of two wires insulated from each other and from earth. You will readily see that although for the convenience of experimental illustration I have placed the generator and motor close together, this proximity was not an essential condition of the experiment. The motor might have been placed in another room, or in a different part of London, and still the experiment would have succeeded, provided I had used sufficiently stout and well-insulated connecting wires. But then you could not have had ocular demonstration of the fact that movement of the generator armature is closely followed by a corresponding movement of the motor armature.

A full treatment of my subject would of course include a complete investigation of the dynamo, but this I shall not attempt. In the first place there is no time for it, and in the second place it is hardly necessary, since you are all more or less acquainted with these machines. I shall therefore not occupy time by giving mathematical proofs for the few formulæ I shall have to use, but assume that they are familiar to you. They are as follows:—

$$\text{Volts} \quad \ldots \quad = \text{H}\, v\, l\, 10^{-8}$$

$$\text{Kilogrammes} \quad = \frac{\text{H}\, c\, l}{9{,}810{,}000}$$

C Total current through armature; c, current through single armature conductor.
e_a E.M.F. in armature in volts.
τ Number of active conductors counted all round armature.
p Number of pairs of poles ($p = 1$ in a two-pole machine.)
n Speed in revolutions per minute.
F Total induction in C.G.S. lines.
Z " " English lines.

Electromotive force.

$$\left.\begin{aligned} e_a &= \text{F}\,\tau\,\frac{n}{60}\,10^{-8} \\ e_a &= \text{Z}\,\tau\,n\,10^{-6} \end{aligned}\right\} \text{for two-pole machines.}$$

$$\left.\begin{aligned} e_a &= p\,\text{F}\,\tau\,\frac{n}{60}\,10^{-1} \\ e_a &= p\,\text{Z}\,\tau\,n\,10^{-6} \end{aligned}\right\} \text{for multipolar machines with series wound armature.}$$

Torque ...

$$\left.\begin{aligned} \text{Kilogramme-metres} &= 1{\cdot}615\,\text{F}\,\tau\,\text{C}\,10^{-10} \\ \text{Foot-pounds} \quad \ldots &= 7{\cdot}05\,\text{Z}\,\tau\,\text{C}\,10^{-6} \end{aligned}\right\} \text{for two-pole machines.}$$

$$\left.\begin{aligned} \text{Kilogramme-metres} &= 3{\cdot}23\,\text{F}\,\tau\,c\,p\,10^{-10} \\ \text{Foot-pounds} \quad \ldots &= 14{\cdot}10\,\text{Z}\,\tau\,c\,p\,10^{-6} \end{aligned}\right\} \text{for multipolar machines.}$$

In analysing these formulæ you will observe a curious parallelism. The symbols for field strength and total number of active armature wires occur in either group, but the current occurs only in the group giving torque, or mechanical turning effort, and the speed occurs only in the group giving E.M.F. Now if you multiply any of the torque formulæ with the speed you get on the left—mechanical power; and on the right the product of electromotive force, multiplied with current and a constant, or, in other words, electrical power; by working this out in figures, you will find that mechanical energy expressed in horse-power is equal to watts divided by 746, the well-known equation for converting mechanical into electric power.

The formulæ are equally applicable to cylinder armatures wound Gramme fashion and to drum armatures, provided we count not turns of wire but active conductors over the whole circumference of the armature. As regards two pole machines, the formulæ are the same as found in every text-book on dynamos, but as regards multipolar machines, a little explanation is required, both as to the winding and as to the advantage or otherwise of using more than one pair of poles. To make the explanation clear I must refer for a moment to the ordinary method of drum winding for two pole armatures. When such a winding is illustrated in a text-book, the author takes care to show only very few conductors, for the simple reason that the diagram would be one unintelligible maze of lines if it were drawn so as to represent an armature as really made. To get over this difficulty I employ, instead of a diagram, a tabular statement of the winding such as you see on the wall. This particular table represents the winding of a drum armature having 100 active conductors.

Drum Winding.

F	B	F	B	F	B	F	B	F	B	F
D	U	D	U	D	U	D	U	D	U	
100	49	−98	47	96	45	94	43	92	41	
90	39	88	37	86	35	84	33	82	31	
80	29	78	27	76	25	74	23	72	21	
70	19	68	17	66	15	64	13	62	11	
60	9	58	7	56	5	54	3	52	1	
50	99	+48	97	46	95	44	93	42	91	
40	89	38	87	36	85	34	83	32	81	
30	79	28	77	26	75	24	73	22	71	
20	69	18	67	16	65	14	63	12	61	
10	59	8	57	6	55	4	53	2	51	
100	49	−98								

The figures at the top of the vertical columns indicate the direction of winding, supposing the winder looks at the armature end on. The letter D signifies a wire, wound down or away from him; and the letter U, a wire wound up or towards him. The letters F and B, placed between the others, denote the front and back connections respectively. In modern machines these connections are not made of flexible wire, but are separate pieces, specially made to shape, and are generally of larger section than the conductor, so as to reduce the resistance of the armature as much as possible. One form of connector is on the table, both in pieces and built up. By referring to the winding table, you will see that every wire is numbered; and thus we can see at a glance how the ends of each wire are connected. The table on the wall refers to a two-pole machine; that on the slip in your hands, to an eight-pole machine, wound so as to obtain the E.M.F. of the four pairs of poles in series. The printed table, giving the eight-pole winding, is almost self-explanatory; but, to assist you in understanding the winding of these multipolar machines generally, I had this model prepared, showing a few of the conductors of a six-pole armature. This method of winding has been invented by Messrs. Scott and Paris, patents 4,683 and 6,261, of 1874. There are no internal cross connections, the ends of the conductors being joined simply by connecting segments of the kind I have just shown you, but with this difference, that each segment, instead of embracing half a circle, embraces only one-sixth of a circle. The winding goes in zig-zag, so to speak, round the armature, returning to the second wire in front or behind the previous starting point. There are thus only two brushes required. The winding tables show, also, very clearly how the E.M.F. increases from wire to wire, and that the greatest difference of potential occurs between neighbouring wires at the diameter of commutation. The difference of potential between neighbouring connector segments is, however, limited to the E.M.F. due to the two conductors. The winding is used for machines intended to give high-pressure currents, such as are required in power transmission. When low-pressure and large currents are required, the winding is altered, so as to form over-lapping loops on the armature, and for intermediate electromotive forces a combination of both methods can be used. But as these windings have no immediate importance for power transmission, I shall not detain you with a description of them.

Table of Winding for 8-Pole Drum Armature; 202 Conductors; Series Winding; Brushes (±) 135° Apart.

F	B	F	B	F	B	F	B	F
D	U	D	U	D	U	D	U	
202	25	50	75	100	125	150	175	
200	23	48	73	98	123	148	173	
198	21	46	71	96	121	146	171	
196	19	−44	69	94	119	144	169	
194	17	42	67	92	117	142	167	
192	15	40	65	90	115	140	165	
190	13	38	63	88	113	138	163	
188	11	36	61	86	111	136	161	
186	9	34	59	84	109	134	159	
184	7	32	57	82	107	132	157	
182	5	30	55	80	105	130	155	
180	3	28	53	78	103	128	153	
178	1	26	51	76	101	126	151	
176	201	24	49	74	99	124	149	
174	199	22	47	72	97	122	147	
172	197	20	45	70	95	+120	145	
170	195	18	43	68	93	118	143	
168	193	16	41	66	91	116	141	
166	191	14	39	64	89	114	139	
164	189	12	37	62	87	112	137	
162	187	10	35	60	85	110	135	
160	185	8	33	58	83	108	133	
158	183	6	31	56	81	106	131	
156	181	4	29	54	79	104	129	
154	179	2	27	52	77	102	127	
152	177	202						

Now, as to the advantage of multipolar machines, such as the one which I illustrated on the screen. The field magnets are arranged perfectly symmetrical round the armature; and thus the one-sided magnetic pull, consequent upon the employment of a single pair of horse-shoe magnets, is avoided. There is very little magnetic leakage, the machine being what is known as iron-clad; and, as I have already shown, the E.M.F. is equivalent to that of several smaller machines, coupled in series. The internal diameter of the armature is very large, affording plenty of space for the ingress and egress of air; and the weight of the machine is less than that of an equivalent two-pole machine. The most important advantage, however, is the small armature reaction. Experience with large two-pole machines has shown that there is a limit to the size above which such machines are satisfactory. This limit depends, of course, on the speed and voltage, as well as on the output; but, roughly speaking, we may take it that, for moderately high voltage, and an output above 100 horse-power, the multipolar machine is preferable; and we find, accordingly,

that, for the transmission of large powers multipolar machines are, as a rule, employed.

I have hitherto not made any distinction between motors and generators, because the difference between them is almost negligible. There are certain secondary effects which may be a little greater in one machine than in the other; but these are of so little importance that it will not be worth while to devote any time to their consideration. As a rule a good generator makes a good motor. All we require to do is to set the brushes a little forward of the neutral line in the former, and a little back from that line in the latter. Now let us see what it is we must naturally aim at in putting up a transmission plant. At the generating end of the line we want as high an E.M.F. as we can get, because a high E.M.F. means large power and small percentage loss due to line resistance. At the motor end we want as large a torque or statical effort as possible, combined with a certain speed. But a glance at the formulæ will show that it is impossible to get speed without also getting E.M.F., which, in the case of the motor, must oppose the current, and thus the current actually flowing through the motor is that due to the difference between the E.M.F. of the generator and the counter E.M.F. of the motor. This difference divided by the total resistance of the circuit gives the current.

The electrical power developed in the generator is the product this current, and the E.M.F. in its armature. The electrical power converted by the motor is the product of the same current and the counter E.M.F. of its armature. It therefore follows that the electrical efficiency of the whole system is given by the ratio between the generator and motor E.M.F. The more nearly alike these two are, that is to say, the less E.M.F. lost in resistance the greater will be the electric efficiency. Now the smaller the current the less E.M.F. is lost in resistance, but to get power with a small current we must work at high pressure, and we thus find that from the point of view of electrical efficiency only, the higher the voltage the better. There are, however, other things to be considered besides electrical efficiency, and if we take due account of these we find that for every case there is one particular voltage at which it is best to work.

Upon this subject I shall enter presently, but before doing so I must place before you some points in connection with the regulation of speed and power in transmission plants. Unless we can control the speed and regulate the power given out at the receiving end of the line, the most perfect motor or the most efficient system is useless. Fortunately, however, electricity is not only a powerful transmitting agent, but also one that can be easily controlled, and my next task is to show you how this control is effected.

(To be continued.)

EXPERIMENTS WITH ALTERNATE CURRENTS OF VERY HIGH FREQUENCY, AND THEIR APPLICATION TO METHODS OF ARTIFICIAL ILLUMINATION.*

By NIKOLA TESLA.

(Concluded from page 151.)

It is likewise practicable to light with one leading wire lamps such as illustrated in fig. 21 and fig. 22, by connecting one terminal of the lamp to one terminal of the source, and the other to an insulated body of the required size. In all cases the insulated body serves to give off the energy into the surrounding space, and is equivalent to a return wire. Obviously, in the two last-named cases, instead of connecting the wires to an insulated body, connections may be made to the ground.

The experiments which will prove most suggestive, and of most interest to the investigator, are probably those performed with exhausted tubes. As might be anticipated, a source of such rapidly alternating potentials is capable of exciting the tubes at a considerable distance, and the light effects produced are remarkable.

During my investigations in this line, I endeavoured to excite tubes, devoid of any electrodes, by electro-magnetic induction, making the tube the secondary of the induction device, and passing through the primary the discharges of a Leyden jar. These tubes were made of many shapes, and I was able to obtain luminous effects which I then thought were due wholly to electro-magnetic induction. But on carefully investigating the phenomena, I found that the effects produced were more of an electrostatic nature. It may be attributed to this circumstance that this mode of exciting tubes is very wasteful, namely, the primary circuit being closed, the potential, and consequently the electrostatic inductive effect, is much diminished.

When an induction coil, operated as above described, is used, there is no doubt that the tubes are excited by electrostatic induction, and that electro-magnetic induction has little, if anything to do with the phenomena.

This is evident from many experiments. For instance, if a tube be taken in one hand, the observer being near the coil, it is brilliantly lighted and remains so, no matter in what position it is held relatively to the observer's body. Were the action electro-magnetic, the tube could not be lighted when the observer's body is interposed between it and the coil, or at least its luminosity should be considerably diminished. When the tube is held exactly over the centre of the coil—the latter being wound in sections, and the primary placed symmetrically to the secondary—it may remain completely dark, whereas it is rendered intensely luminous by moving it slightly to the right or left from the centre of the coil. It does not light, because in the middle both halves of the coil neutralise each other, and the electric potential is zero. If the action were electro-magnetic, the tube should light best in the plane through the centre of the coil, since the electro-magnetic effect there should be a maximum. When an arc is established between the terminals, the tubes and lamps in the vicinity of the coil go out, but light up again when the arc is broken, on account of the rise of potential. Yet the electro-magnetic effect should be practically the same in both cases.

By placing a tube at some distance from the coil, and nearer to one terminal—preferably at a point on the axis of the coil—one may light it by touching the remote terminal with an insulated body of some size or with the hand, thereby raising the potential at that terminal nearer to the tube. If the tube is shifted nearer to the coil so that it is lighted by the action of the nearer terminal, it may be made to go out by holding, on an insulated support, the end of a wire connected to the remote terminal, in the vicinity of the nearer terminal, by this means counteracting the action of the latter upon the tube. These effects are evidently electrostatic. Likewise, when a tube is placed at a considerable distance from the coil, the observer may, standing upon an insulated support, between coil and tube, light the latter by approaching the hand to it; or he may even render it luminous by simply stepping between it and the coil. This would be impossible with electro-magnetic induction, for the body of the observer would act as a screen.

When the coil is energised by excessively weak currents, the experimenter may, by touching one terminal of the coil with the tube, extinguish the latter, and may again light it by bringing it out of contact with the terminal and allowing a small arc to form. This is clearly due to the respective lowering and raising of the potential at that terminal. In the above experiment, when the tube is lighted through a small arc, it may go out when the arc is broken, because the electrostatic inductive effect alone is too weak, though the potential may be much higher; but when the arc is established, the electrification of the end of the tube is much greater, and it consequently lights.

If a tube is lighted by holding it near to the coil, and in the hand which is remote, by grasping the tube anywhere with the other hand, the part between the hands is rendered dark, and the singular effect of wiping out the light of the tube may be produced by passing the hand quickly along the tube, and at the same time withdrawing it gently from the coil, judging properly the distance so that the tube remains dark afterwards.

If the primary coil is placed sidewise, as in fig. 17B for instance, and an exhausted tube be introduced from the other side in the hollow space, the tube is lighted most intensely because of the increased condenser action, and in this position the striæ are most sharply defined. In all these experiments described, and in many others, the action is clearly electrostatic.

The effects of screening also indicate the electrostatic nature of the phenomena, and show something of the nature of electrification through the air. For instance, if a tube be placed in the direction of the axis of the coil, and an insulated metal plate be interposed, the tube will generally increase in brilliancy, or if it be too far from the coil to light, it may even be rendered luminous by interposing an insulated metal plate. The magnitude of the effects depends to some extent on the size of the plate. But if the metal plate be connected by a wire to the ground, its interposition will always make the tube go out, even if it be very near the coil. In general, the interposition of a body between the coil and tube increases or diminishes the brilliancy of the tube, or its facility to light up, according to whether it increases or diminishes the electrification. When experimenting with an insulated plate, the plate should not be taken too large, else it will generally produce a weakening effect by reason of its great facility for giving off energy to the surroundings.

If a tube be lighted at some distance from the coil, and a plate of hard rubber or other insulating substance be interposed, the tube may be made to go out. The interposition of the dielectric in this case only slightly increases the inductive effect, but diminishes considerably the electrification through the air.

In all the cases, then, when we excite luminosity in exhausted tubes by means of such a coil, the effect is due to the rapidly alternating electrostatic potential; and, furthermore, it must be attributed to the harmonic alternation produced directly by the machine, and not to any superimposed vibration which might be thought to exist. Such superimposed vibrations are impossible when we work with an alternate current machine. If a spring be gradually tightened and released, it does not perform independent vibrations; for this a sudden release is necessary. So with the alternate currents from a dynamo machine; the medium is harmonically strained and released, this giving rise to only one kind of waves; a sudden contact or break, or a sudden giving way of the dielectric, as in the disruptive discharge of a Leyden jar, are essential for the production of superimposed waves.

In all the last described experiments, tubes devoid of any electrodes may be used, and there is no difficulty in producing by their means sufficient light to read by. The light effect is, however, considerably increased by the use of phosphorescent bodies such as yttria, uranium glass, &c. A difficulty will be found when the phosphorescent material is used, for with these powerful effects it is carried gradually away, and it is preferable to use material in the form of a solid.

Instead of depending on induction at a distance to light the tube, the same may be provided with an external—and, if desired, also with an internal—condenser coating, and it may then be suspended

* A lecture delivered before the American Institute of Electrical Engineers, at Columbia College, N.Y., May 20th, 1891.

anywhere in the room from a conductor connected to one terminal of the coil, and in this manner a soft illumination may be provided.

The ideal way of lighting a hall or room would, however, be to produce such a condition in it that an illuminating device could be moved and put anywhere, and that it is lighted, no matter where it is put and without being electrically connected to anything. I have been able to produce such a condition by creating in the room a powerful, rapidly alternating electrostatic field. For this purpose I suspend a sheet of metal a distance from the ceiling on insulating cords and connect it to one terminal of the induction coil, the other terminal being preferably connected to the ground. Or else I suspend two sheets as illustrated in fig. 30, each sheet being connected with one of the terminals of the coil, and their size being carefully determined. An exhausted tube may then be carried in the hand anywhere between the sheets or placed anywhere, even a certain distance beyond them; it remains always luminous.

In such an electrostatic field interesting phenomena may be observed, especially if the alternations are kept low and the potentials excessively high. In addition to the luminous phenomena mentioned, one may observe that any insulated conductor gives sparks when the hand or another object is approached to it, and the sparks may often be powerful. When a large conducting object is fastened on an insulating support, and the hand approached to it, a vibration, due to the rythmical motion of the air molecules is felt, and luminous streams may be perceived when the hand is held near a pointed projection. When a telephone receiver is made to touch with one or both of its terminals an insulated conductor of some size, the telephone emits a loud sound; it also emits a sound when a length of wire is attached to one or both terminals, and with very powerful fields a sound may be perceived even without any wire.

How far this principle is capable of practical application, the future will tell. It might be thought that electrostatic effects are unsuited for such action at a distance. Electro-magnetic inductive effects, if available for the production of light, might be thought better suited. It is true the electrostatic effects diminish nearly with the cube of the distance from the coil, whereas the electro-magnetic inductive effects diminish simply with the distance. But when we establish an electrostatic field of force, the condition is very different, for then, instead of the differential effect of both the terminals, we get their conjoint effect. Besides, I would call attention to the fact, that in an alternating electrostatic field, a conductor, such as an exhausted tube, for instance, tends to take up most of the energy, whereas in an electro-magnetic alternating field the conductor tends to take up the least energy, the waves being reflected with but little loss. This is one reason why it is difficult to excite an exhausted tube, at a distance, by electro-magnetic induction. I have wound coils of very large diameter and of many turns of wire, and connected a Geissler tube to the ends of the coil with the object of exciting the tube at a distance; but even with the powerful inductive effects producible by Leyden jar discharges the tube could not be excited unless at a very small distance, although some judgment was used as to the dimensions of the coil. I have also found that even the most powerful Leyden jar discharges are capable of exciting only feeble luminous effects in a closed exhausted tube, and even these effects upon thorough examination I have been forced to consider of an electrostatic nature.

How, then, can we hope to produce the required effects at a distance by means of electro-magnetic action, when even in the closest proximity to the source of disturbance, under the most advantageous conditions, we can excite but faint luminosity? It is true that when acting at a distance we have the resonance to help us out. We can connect an exhausted tube, or whatever the illuminating device may be, with an insulated system of the proper capacity, and so it may be possible to increase the effect qualitatively, and only qualitatively, for we would not get *more* energy through the device. So we may, by resonance effect, obtain the required electromotive force in an exhausted tube, and excite faint luminous effects, but we cannot get enough energy to render the light practically available, and a simple calculation, based on experimental results, shows that even if all the energy which a tube would receive at a certain distance from the source should be wholly converted into light, it would hardly satisfy the practical requirements. Hence the necessity of directing, by means of a conducting circuit, the energy to the place of transformation. But in so doing we cannot very sensibly depart from present methods, and all we could do would be to improve the apparatus.

From these considerations it would seem that if this ideal way of lighting is to be rendered practicable it will be only by the use of electrostatic effects. In such a case the most powerful electrostatic inductive effects are needed; the apparatus employed must, therefore, be capable of producing high electrostatic potentials changing in value with extreme rapidity. High frequencies are especially wanted, for practical considerations make it desirable to keep down the potential. By the employment of machines, or, generally speaking, of any mechanical apparatus, but low frequencies can be reached; recourse must, therefore, be had to some other means. The discharge of a condenser affords us a means of obtaining frequencies by far higher than are obtainable mechanically, and I have accordingly employed condensers in the experiments to the above end.

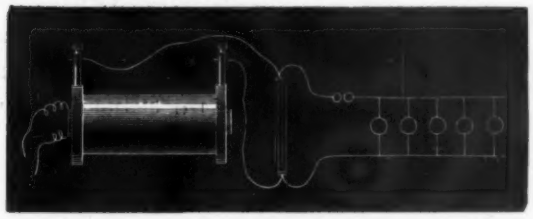

FIG. 31.—DIAGRAM OF CONNECTIONS FOR CONVERTING FROM HIGH TO LOW TENSION BY MEANS OF THE DISRUPTIVE DISCHARGE.

When the terminals of a high tension induction coil, fig. 31, are connected to a Leyden jar, and the latter is discharging disruptively into a circuit, we may look upon the arc playing between the knobs as being a source of alternating, or generally speaking, undulating currents, and then we have to deal with the familiar system of a generator of such currents, a circuit connected to it, and a condenser bridging the circuit. The condenser in such a case is a veritable transformer, and since the frequency is excessive, almost any ratio in the strength of the currents in both the branches may be obtained. In reality the analogy is not quite complete, for in the disruptive discharge we have most generally a fundamental instantaneous variation of comparatively low frequency, and a superimposed harmonic vibration, and the laws governing the flow of currents are not the same for both.

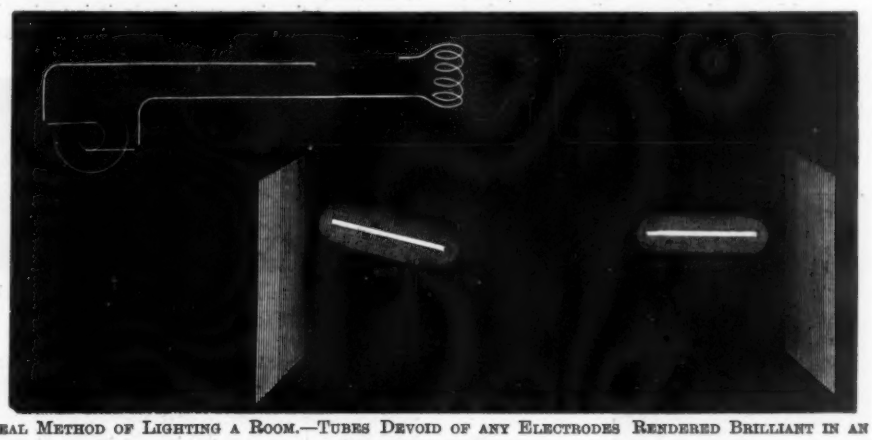

FIG. 30.—IDEAL METHOD OF LIGHTING A ROOM.—TUBES DEVOID OF ANY ELECTRODES RENDERED BRILLIANT IN AN ALTERNATING ELECTROSTATIC FIELD.

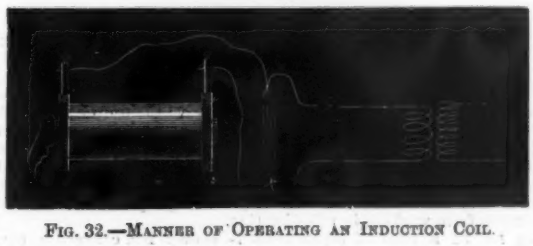

FIG. 32.—MANNER OF OPERATING AN INDUCTION COIL.

In converting in this manner, the ratio of conversion should not be too great, for the loss in the arc between the knobs increases with the square of the current, and if the jar be discharged through very thick and short conductors, with the view of obtaining a very rapid oscillation, a very considerable portion of the energy stored is lost. On the other hand, two small ratios are not practicable for many obvious reasons.

As the converted currents flow in a practically closed circuit, the

electrostatic effects are necessarily small, and I therefore convert them into currents or effects of the required character. I have effected such conversions in several ways. The preferred plan of connections is illustrated in fig. 32. The manner of operating renders it easy to obtain by means of a small and inexpensive apparatus enormous differences of potential which have been usually obtained by means of large and expensive coils. For this it is only necessary to take an ordinary small coil, adjust to it a condenser and discharging circuit, forming the primary of an auxiliary small coil, and convert upward. As the inductive effect of the primary currents is excessively great, the second coil need have comparatively but very few turns. By properly adjusting the elements, remarkable results may be secured.

In endeavouring to obtain the required electrostatic effects in this manner, I have, as might be expected, encountered many difficulties which I have been gradually overcoming, but I am not as yet prepared to dwell upon my experiences in this direction.

I believe that the disruptive discharge of a condenser will play an important part in the future, for it offers vast possibilities, not only in the way of producing light in a more efficient manner and in the line indicated by theory, but also in many other respects.

For years the efforts of inventors have been directed towards obtaining electrical energy from heat by means of the thermopile. It might seem invidious to remark that but few know what is the real trouble with the thermopile. It is not the inefficiency or small output—though these are great drawbacks—but the fact that the thermopile has its phylloxera, that is, that by constant use it is deteriorated, which has thus far prevented its introduction on an industrial scale. Now that all modern research seems to point with certainty to the use of electricity of excessively high tension, the question must present itself to many whether it is not possible to obtain in a practicable manner this form of energy from heat. We have been used to look upon an electrostatic machine as a plaything, and somehow we couple with it the idea of the inefficient and impractical. But now we must think differently, for now we know that everywhere we have to deal with the same forces, and that it is a mere question of inventing proper methods or apparatus for rendering them available.

In the present systems of electrical distribution, the employment of the iron with its wonderful magnetic properties allows us to reduce considerably the size of the apparatus; but, in spite of this, it is still very cumbersome. The more we progress in the study of electric and magnetic phenomena, the more we become convinced that the present methods will be short lived. For the production of light, at least, such heavy machinery would seem to be unnecessary. The energy required is very small, and if light can be obtained as efficiently as, theoretically, it appears possible, the apparatus need have but a very small output. There being a strong probability that the

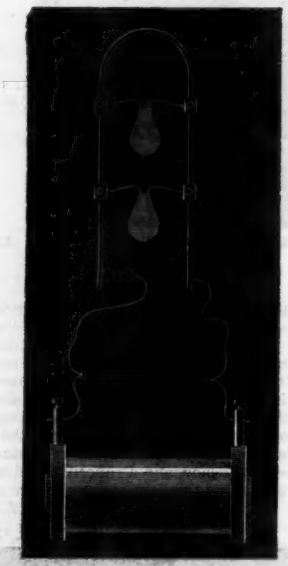

FIG. 33.—LAMP KEPT AT INCANDESCENCE ACROSS A THICK COPPER BAR—SHOWING NODES.

illuminating methods of the future will involve the use of very high potentials, it seems very desirable to perfect a contrivance capable of converting the energy of heat into energy of the requisite form. Nothing to speak of has been done towards this end, for the thought that electricity of some 50,000 or 100,000 volts pressure or more, even if obtained, would be unavailable for practical purposes, has deterred inventors from working in this direction.

In fig. 31 a plan of connections is shown for converting currents of high into currents of low tension, by means of the disruptive discharge of a condenser. This plan has been used by me frequently for operating a few incandescent lamps required in the laboratory. Some difficulties have been encountered in the arc of the discharge, which I have been able to overcome to a great extent; besides this, and the adjustment necessary for the proper working, no other difficulties have been met with, and it was easy to operate ordinary lamps, and even motors, in this manner. The line being connected to the ground, all the wires could be handled with perfect impunity, no matter how high the potential at the terminals of the condenser. In these experiments a high tension induction coil, operated from a battery or from an alternate current machine, was employed to charge the condenser; but the induction coil might be replaced by an apparatus of a different kind, capable of giving electricity of such high tension. In this manner, direct or alternating currents may be converted, and in both cases the current impulses may be of any desired frequency. When the currents charging the condenser are of the same direction, and it is desired that the converted currents should also be of one direction, the resistance of the discharging circuit should, of course, be so chosen that there are no oscillations.

In operating devices on the above plan, I have observed curious phenomena of impedance which are of interest. For instance, if a thick copper bar be bent, as indicated in fig. 33, and shunted by ordinary incandescent lamps, then, by passing the discharge between the knobs, the lamps may be brought to incandescence, although they are short-circuited. When a large induction coil is employed it is easy to obtain nodes on the bar, which are rendered evident by the different degree of brilliancy of the lamps, as shown roughly in fig. 33. The nodes are never clearly defined, but there are simply maxima and minima of potentials along the bar. This is probably due to the irregularity of the arc between the knobs. In general, when the above-described plan of conversion from high to low tension is used, the behaviour of the disruptive discharge may be closely studied. The nodes may also be investigated by means of an ordinary Cardew voltmeter, which should be well insulated. Geissler tubes may also be lighted across the points of the bent bar; in this case, of course, it is better to employ smaller capacities. I have found it practicable to light up in this manner a lamp, and even a Geissler tube, shunted by a short heavy block of metal, and this result seems at first very curious. In fact, the thicker the copper bar in fig. 33, the better it is for the success of the experiments, as they appear more striking. When lamps with long slender filaments are used, it will be often noted that the filaments are from time to time violently vibrated, the vibration being smallest at the nodal points. This vibration seems to be due to an electrostatic action between the filament and the glass of the bulb.

In some of the above experiments, it is preferable to use special lamps having a straight filament, as shown in fig. 34. When such

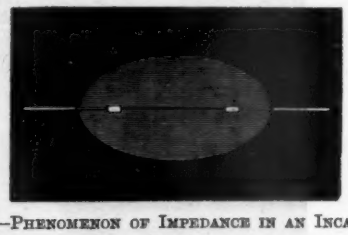

FIG. 34.—PHENOMENON OF IMPEDANCE IN AN INCANDESCENT LAMP.

a lamp is used a still more curious phenomenon than those described may be observed. The lamp may be placed across the copper bar and lighted, and by using somewhat larger capacities, or, in other words, smaller frequencies, or smaller impulsive impedances, the filament may be brought to any desired degree of incandescence. But when the impedance is increased, a point is reached when comparatively little current passes through the carbon, and most of it through the rarefied gas; or perhaps it may be more correct to state that the current divides nearly evenly through both, in spite of the enormous difference in the resistance, and this would be true unless the gas and the filament behave differently. It is then noted that the whole bulb is brilliantly illuminated, and the ends of the leading-in wires become incandescent, and often throw off sparks in consequence of the violent bombardment, but the carbon filament remains dark. This is illustrated in fig. 34. Instead of the filament, a single wire extending through the whole bulb may be used, and in this case the phenomenon would seem to be still more interesting.

From the above experiment it will be evident that, when ordinary lamps are operated by the converted currents, those should be preferably taken in which the platinum wires are far apart, and the frequencies used should not be too great, else the discharge will occur at the ends of the filament or in the base of the lamp between the leading-in wires, and the lamp might then be damaged.

In presenting to you these results of my investigation on the subject under consideration, I have paid only a passing notice to facts upon which I could have dwelt at length, and among many observations I have selected only those which I thought most likely to interest you. The field is wide and completely unexplored, and at every step a new truth is gleaned, a novel fact observed.

How far the results here borne out are capable of practical applications will be decided in the future. As regards the production of light, some results already reached are encouraging, and make me confident in asserting that the practical solution of the problem lies in the direction I have endeavoured to indicate. Still, whatever may be the immediate outcome of these experiments I am hopeful that they will only prove a step to further development towards the ideal and final perfection. The possibilities which are opened by modern research are so vast that even the most reserved must feel sanguine of the future. Eminent scientists consider the problem of utilising one kind of radiation without the others a rational one. In an apparatus designed for the production of light by conversion from any form of energy into that of light, such a result can never be reached, for no matter what the process of producing the required

vibrations, be it electrical, chemical, or any other, it will not be possible to obtain the higher light vibrations without going through the lower heat vibrations. It is the problem of imparting to a body a certain velocity without passing through all lower velocities. But there is a possibility of obtaining energy not only in the form of light, but motive power and energy of any other form, in some more direct way from the medium. The time will be when this will be accomplished, and the time has come when one may utter such words before an enlightened audience without being considered a visionary, We are whirling through endless space with an inconceivable speed, all around us everything is spinning, everything is moving, everywhere is energy. There *must* be some way of availing ourselves of this energy more directly. Then, with the light obtained from the medium, with the power derived from it, with every form of energy obtained without effort, from the store for ever inexhaustible, humanity will advance with giant strides. The mere contemplation of these magnificent possibilities expands our minds, strengthens our hopes, and fills our hearts with supreme delight.

NEW PATENTS—1891.

12,286. "Economic electro-motor and motive power." C. S. F. MELLOR. Dated July 20th.

12,296. "Improvements in apparatus for the manufacture, by electrolysis, of tubes and other articles of circular section." A. S. ELMORE. Dated July 20th.

12,309. "Improvements in or relating to railway switches, signals, and the like." A. J. BOULT. (Communicated by The Standard Equipment Company, United States.) Dated July 20th. (*Complete.*)

12,313. "Improvements in electric batteries." E. C. C. JUNGNICKEL. Dated July 20th.

12,322. "Improvements in or relating to electrical welding." A. J. BOULT. (Communicated by J. H. Bassler, United States.) Dated July 21st. (*Complete.*)

12,384. "Improved compound for insulating electric wires in general." M. MACKAY. Dated July 21st.

12,415. "Improvements in and relating to quick hitching harness and its operation by electric current." F. E. STUART. Dated July 22nd.

12,416. "Improvements in telephonic transmitters." A. MARR. Dated July 22nd.

12,455. "Improvements in electric locomotives." J. WETTER. (Communicated by H. Bonneau, France.) Dated July 22nd. (*Complete.*)

12,484. "Improvements in telephonic switching apparatus." A. R. BENNETT. Dated July 23rd.

12,491. "Improvements in the construction of rheostats or similar electrical instruments." C. L. BAKER and WOODHOUSE AND RAWSON UNITED, LIMITED. Dated July 23rd.

12,503. "An improved electric ear-ring for curative and remedial purposes." E. OWEN. Dated July 23rd.

12,525. "Electrical steering gear." G. S. GRIMSTON and A. H. DYKES. Dated July 23rd.

12,529. "Improvements in means for distributing electric currents." H. EDMUNDS. Dated July 23rd.

12,531. "A new or improved apparatus for producing pictures upon a screen in stereoscopic relief by means of electricity." D. BOUCHARD. Dated July 23rd.

12,535. "Improvements in switches for electric installations." A. V. NEWTON. (Communicated by A. Swan, United States.) Dated July 23rd.

12,540. "Dynamo-electric machines." H. CUENOD, E. SAUTTER, and G. HOCHREUTINER. Dated July 23rd. (*Complete.*) [Date applied for under Patents Act, 1883, sec. 103, 31st December, 1890, being date of application in Switzerland.]

12,541. "A system for the automatic regulation of the position of the brushes of dynamo-electric machines, magneto-electric machines, and electric motors." H. CUENOD, E. SAUTTER, and G. HOCHREUTINER. Dated July 23rd. (*Complete.*) [Date applied for under Patents Act, 1883, sec. 103, 31st December, 1890, being date of application in Switzerland.]

12,592. "Improvements relating to the manufacture or preparation of carbons for electric lamps or lighting apparatus." H. H. LAKE. (Communicated by Lacombe & Co., France.) Dated July 24th.

12,602. "Improvements in apparatus for measuring electric currents." H. ARON. Dated July 24th.

12,605. "Improved means for securing terminals or binding-screws to plates or electrodes for electric batteries." H. H. LAKE. (Communicated by Lacombe & Co., France.) Dated July 24th.

12,611. "Improvements in or connected with the electrolytic deposition of copper." J. W. SWAN. Dated July 24th.

12,622. "An improvement in electric clocks." N. WELLS. Dated July 25th.

12,628. "Improvements in couplings and terminal connections for electric cables." J. J. HARGREAVES and R. W. NUTTALL. Dated July 25th.

12,634. "Improvements in apparatus for electrical sound and sight signalling on railways and other lines of rail." A. D. MACDONALD and J. DODD. Dated July 25th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1890.

7,513. "Improvements in the manufacture of electrodes for secondary batteries." W. L. WISE. (A communication from Dr. P. Schoop, of Switzerland.) Dated May 14th. 6d. Claims:—1. In the manufacture of an electrode for a secondary battery, subjecting a lead plate or body to an electro-chemical treatment, such as hereinabove described, in a bath composed of an electro-negative halogen compound, a salt of sulphuric acid, and water, with or without addition of free sulphuric acid, as set forth. 2. In the manufacture of electrodes for secondary batteries by electro-chemical treatment of a lead plate, as set forth, the use of a bath composed of an electro-negative halogen compound, a sulphate or bisulphate, or both, and water, with or without addition of sulphuric acid, substantially as described. 3. The described improved manufacture of electrodes for secondary batteries.

8,116. "Improved handles for electrical switches." G. BINSWANGER and G. FRANKE. Dated May 24th. 6d. The handle, which may be of any of the well-known forms and of any suitable material, is formed with an axial cylindrical hole in it which may extend either partially or quite through. At right angles to this recess or hole another hole is formed which may extend partially or wholly across, and of such a shape that it allows the handle to turn through the required angle to operate the switch when the hereinafter mentioned pin is inserted. The sides of this hole may be parallel, or when preferred it is obvious that the hole may be wider at outside of the handle and narrower at the centre. To the part of the switch to which this handle is to be applied a stud is attached of such a size and shape as to fit easily the axial recess or hole in the handle, the said stud having a hole across it whose centre coincides with the centre of the cross hole of handle. The handle being on the stud, a pin or cross bar is passed into its cross hole and into the hole in the stud, being secured to the latter. Whilst the handle is free to turn partially on its axis, the amount of turning being limited by the width of the hole, the handle is prevented from coming away from the switch stud. 1 claim.

8,153. "Improvements in or appertaining to the charging and working of accumulators in electric light installations and the like." A. B. HOLMES. Dated May 24th. 6d. The inventor divides the entire range of accumulators into two parts, and couples the two in parallel circuit with the dynamo or supply mains, adding resistance coils or their equivalent sufficient to reduce the charging current as required. When the accumulators are required for service the two half sets of accumulators are again connected, at the same time cutting off the resistance coils and connections. 2 claims.

8,174. "Electrical apparatus for transmitting to a distance the rotation of a signalling or indicating axis." J. RICHARD and F. RICHARD. Dated May 24th. 8d. Claims:—1. The combination of a transmitter, with three contacts and corresponding conductors, with a receiver having three corresponding electro-magnets acting by their spring armatures on a four-toothed wheel, the axis of which is thus caused to turn in correspondence with the distant axis working the transmitter, substantially as described. 2. In combination with the armature of each of the receiver electro-magnets, a contact which is broken at the moment when the armature is attached, thereby cutting the magnet out of circuit, substantially as and for the purpose set forth. 3. In combination with the receiver having armatures arranged as in the preceding claim, a fourth electro-magnet and armature engaging a wheel with 12 notches on the receiver axis, substantially as described.

21,183. "Electric protective and signal systems and apparatus." B. J. B. MILLS. (A communication from abroad by C. E. Ongley, of New York.) Dated December 30th. 2s. 2d. The object of this invention is to provide an arrangement of electrical circuits and apparatus for large buildings, such as factories, and hotels, by means of which a complete system of indication may be provided at a central point of various operations which occur in other parts of the building. The arrangement includes a watchman's time indicating apparatus or register arranged to be operated from any one of a number of points, and to give a permanent record of the time at which, and the place from which the signal is sent in, so that the movements of the watchman will be accurately noted. The time indicator is also arranged to indicate the time when the engine in the building is started and shut down. The valve which controls the stopping and starting of the engine is arranged to be operated by an electro-magnet, and such magnet is also controlled from the different parts of the building. Further, the electrical system is connected with a valve controlling the operation of a steam pump or other fire extinguishing apparatus, and also with a fire alarm apparatus. 26 claims.

CORRESPONDENCE.

"Subsidy by Specification."

We think the time has arrived for a strong protest against the manifest injustice of "Specifications for Insulated Wires," as now issued by the engineers of some public and semi-public bodies.

We cannot believe that any other than an electrical engineer would submit to a clause to the effect that "the wires

to be used shall be Messrs. Blank & Co.'s Class 'Z,'" yet this is what actually occurs almost daily, in face of the fact that there are other manufacturers in the field who make an equally reliable wire. Apart from our own interest as manufacturers, we wish to point out that this is also very unfair to the electric light contractor. We have known many instances where influential contractors have snapped their fingers at the wire specification and the "specifier," simply informing the latter that they were going to put in such-and-such a wire made by so-and-so, and defying him to take exception to it, as it fulfilled all the conditions of the specification with the exception of being manufactured by Messrs. Blank & Co., and in some cases expressing the opinion that it was impertinent on his part to tell them that they *must* buy their wires where he thought fit.

The contractor without influential connections cannot adopt this course, and in all cases has to follow such dictation, however arbitrary. We maintain that it is outrageous to hold one man to conditions which another is powerful enough to disregard.

We do not seek to have our name inserted in any specification as an alternative to that of the favoured manufacturer (although we are aware that our name often appears, but the favour has been unsought by us), but contend that specifications for wire should stipulate certain conditions as to nature of insulation, guaranteed tests, &c., and allow the electric light contractor to use his own discretion as to where he purchases his material, and thus put an end to the present system of what may be termed "Subsidy by Specification."

All we ask is "a fair field and no favour."

W. T. Henley's Telegraph Works Co., Ld.

G. SUTTON, *Manager and Secretary.*

[We have on more than one occasion drawn attention to this grievance, and we hope that the protest of Messrs. Henley's will be followed by others.—EDS. ELEC. REV.]

Electrostatic Induction.

With regard to the above article in your last week's issue, I should be glad if you will kindly insert the following corrections.

In fig. 7, the words "External earth-connected surfaces" refer to the outer circle, and should have been printed around it. Fig. 10 is incorrect. The lines should not be radii of the circle, but should be drawn from the divisions on the circle, *normal to the ellipse*. They would then show the greater density at the ends, not at the sides of the ellipse. With regard to fig. 13, I may mention that the inclined dotted lines show the fall of potential along the conductors, corresponding to the fall in potential of the static strain as it travels along.

J. E. Taylor.

City of London Electric Lighting Company.

The article in the REVIEW of 17th inst. in reference to the prospectus of the above company, has interested me greatly, and I think the remarks contained therein are perfectly justified; but there is one point which both your paper and the prospectus in question seem to have overlooked, and that is, the income arising from the sale of *power*. I venture to think that this source of income will quite astonish the directors of the company in question, in fact that it will be the salvation of the undertaking. I do not speak without experience, having introduced electrical transmission of power in this town with such success that I have every reason to believe in a great future for this modern convenience, as opposed to steam and gas engines.

We are running a small station here of about 350 horse-power and, within a few months have installed Crompton motors for, together, some 50 H.P., the motors ranging from $\frac{1}{10}$th H.P. up to 10 H.P., this in a town of 100,000 inhabitants, and this is only a small beginning, as we are now getting enquiries every week for power and are at present installing several motors. Nearly all these motors run on the meter system (Aron's meter), and the users (amongst these such as have thrown out gas engines) are, to a man, highly satisfied.

When I think of the quantity of power used in the City of London, within a very small radius, I feel confident a good business must result to any company taking up the matter seriously, especially if they, as we, use triple expansion condensing engines.

James G. Calvert,

Managing Director of the Elektron Lighting Company, Limited, Gothenburg.

[The question of motive power supply was not overlooked by us and probably the compilers of the company's prospectus also bore it in mind, but so far as any prospects of securing a revenue in this direction are concerned, the employment of electro-motors here has been so limited, that the directors would have scarcely been justified in speculating on what the future had in store. Nevertheless, we are glad to insert Mr. Calvert's letter, and we trust that it may be the means of directing serious attention to the supply of motive power in London and the large manufacturing towns of England generally.—EDS. ELEC. REV.]

Values of γ and $\jmath$.—Careless Reading.

Kindly allow me to correct a clerical error in my last letter. The ratio, E, of the volume at temperature of boiling water to volume at temperature of melting ice should be the ratio $1+E$.

William Donaldson.

August 4th, 1891.

The System of the Société Française des Télégraphes Sous-Marins.

On the 31st ultimo, my engineer-in-chief, Mr. Theophilus Smith, telegraphed me that the Cayenne-Viseo cable was successfully laid. This completes the system of about 2,500 nautical miles which, as the acting partner (for this special purpose) of the Société Générale des Téléphones, I undertook to lay for the Société Française des Telegraphes Sous-Marins under contracts made in July and August of last year.

The programme of the first expedition was drawn up on September 17th, 1890. It was to commence on October 15th and to last 78 days; but subsequently 14 days' extra work were added to the programme thus extending it to 92 days.

The *Westmeath* passed Dover on October 17th outward; and on January 17th homeward bound (92 days).

The programme of the second expedition was drawn up on March 6th, 1891. It was to commence about April 20th and to last 117 days. The *Westmeath* sailed on April 22nd and completed her work on July 31st (100 days). The voyage home would occupy 17 or 18 days if the *Westmeath* came direct; but it has recently been decided to give the ship extra work in laying the spare cable between St. Pierre and Fort-de-France, and elsewhere.

The *Ludgate* was taken up for a minimum period of four months; she will be re-delivered to her owners before its expiration. During these four months she has been fitted with cable-tanks and gear, she has laid 2,250 tons of cable between Surinam and Brazil, and she is now being dismantled for restoration to her owners.

The first expedition was directed by myself in person; the second has been entrusted by me to Mr. Theophilus Smith who is assisted by Messrs. Stallibrass, Page, Schischkar, Hall, Roussel, Fisher, Bevan, Sullivan, Spain, and other engineers and electricians, as well as by Captain Stonehouse and Mr. Dunn, the chief of the engine room.

I will avail myself of this occasion to correct an error that I noticed in a recent number of your journal. Mr. Ernest Vlasto is not the "Deputy Manager" at Calais; but he is one of the directors of the Société Générale des Téléphones who has been deputed by his colleagues to manage their works at Bézons and Calais. About three-fifths of these cables have been constructed by Mr. Vlasto this year; the first two-fifths having been ordered of Henley's Company before Mr. Vlasto had laid his foundations in the Carnot Dock at Calais.

Successful though they have been, Mr. Vlasto's labours were very much increased, owing to the enormous delay in the supply of sheathing machinery from Manchester.

W. Sharpey Seaton.

August 4th, 1891.